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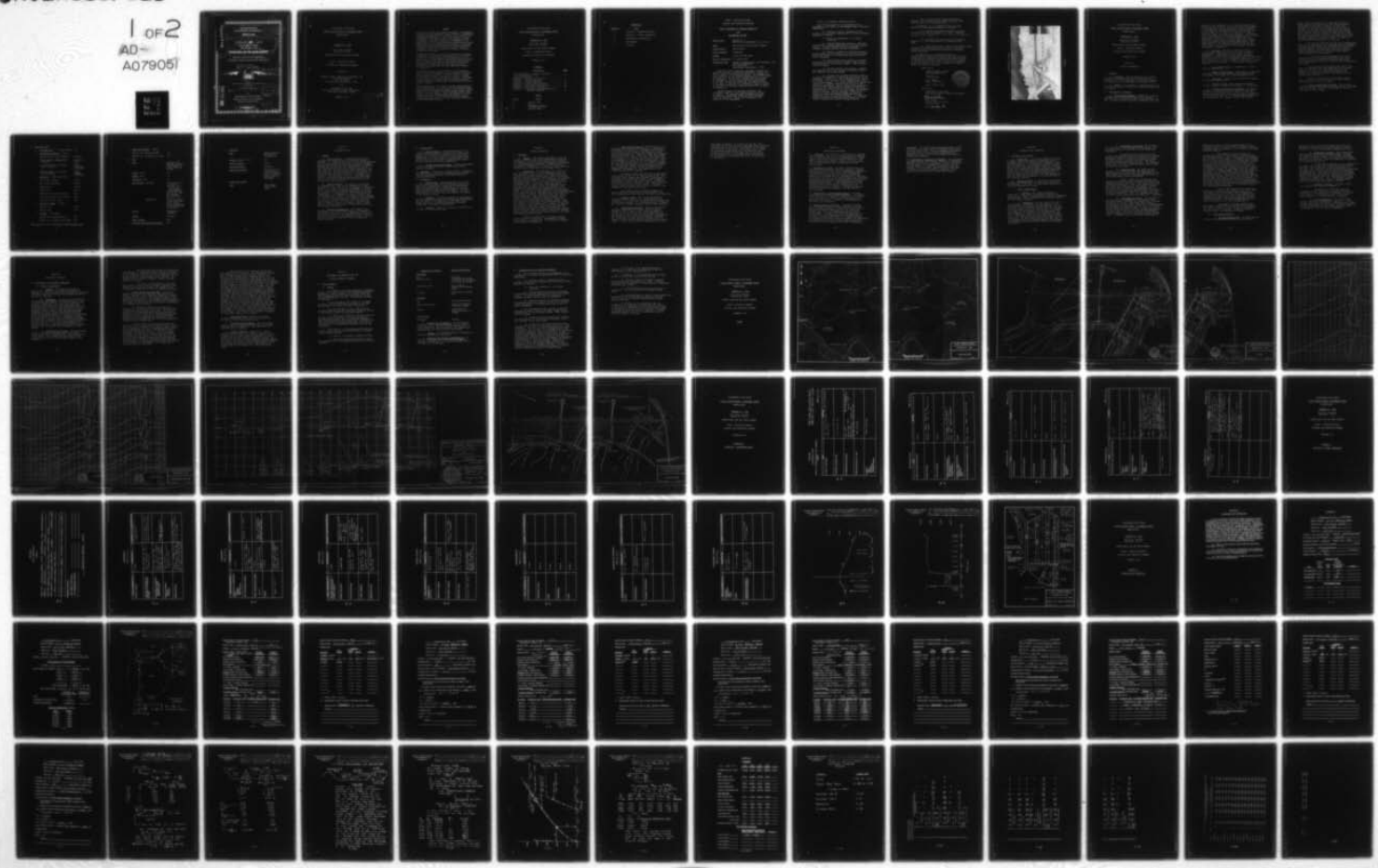

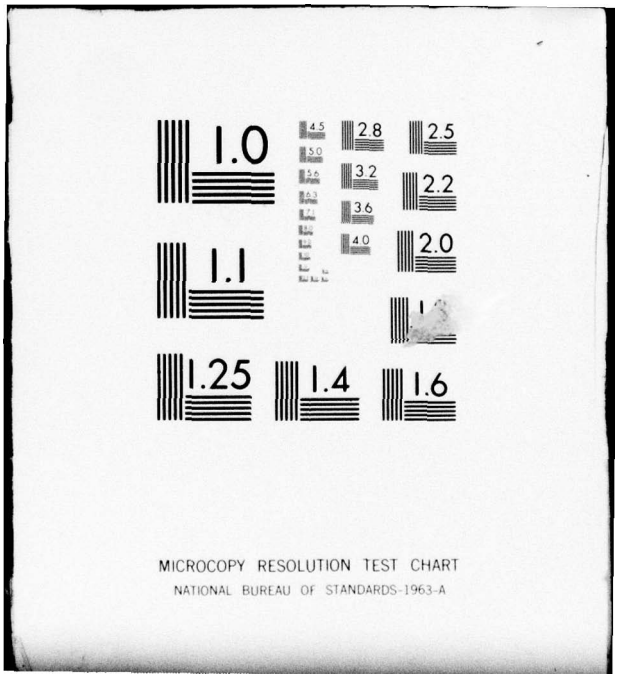
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SUSQUEHANNA RIVER BASIN,
LITTLE ROARING BROOK, LACKAWANNA COUNTY,
PENNSYLVANIA.

LEVEL II

National Dam Inspection Program.

DUNMORE [redacted] 1 DAM

NDI ID [redacted]. PA-00364
DER ID NO. 35-25,

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM

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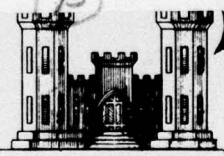
Albert Charles Hooke



Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

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P.O. Box 1963
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For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

FEBRUARY 1979

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of dam:	Dunmore No. 1 NDI ID No. PA-00364/DER ID No. 35-25
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Little Roaring Brook
Date of Inspection:	24 October 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations and past operational performance, Dunmore No. 1 Dam is judged to be in good condition. The spillway can pass 84 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. The spillway capacity is rated as inadequate. Two culverts, immediately downstream of the dam, may provide significant tailwater effects at the dam. If the top of the dam were raised 0.4 foot to its design elevation, the spillway can pass 90 percent of the PMF. The spillway capacity would still be rated as inadequate.

Because there is no analysis available, the structural stability of the masonry gravity spillway is unknown. The spillway right training wall does not have any significant deviations from the guidelines for stability. There is no evidence of instability on the embankment.

There is no emergency drawdown facility.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform a study to determine if the spillway is structurally adequate and to perform remedial measures as required.

(2) Raise the embankment to its design elevation.

(3) Perform additional studies to determine the emergency drawdown capabilities of the water supply line(s). If these capabilities are inadequate, an emergency drawdown facility should be provided.

(4) Repair or replace the existing riprap on the upstream slope and extend it to the top of the dam. Extend the riprap on the downstream slope across the entire embankment.

(5) Perform additional studies to determine the erosion hazard caused by the small bridge at the downstream end of the spillway channel. Take remedial action as needed.

(6) Visually monitor the spalling, cracking, and deterioration of the concrete and masonry joints. Take remedial action when needed.

(7) Install four or more observation wells, or other instrumentation, downstream of the axis of the embankment. One well, or other instrumentation, should be located in the vicinity of the seepage area in the outlet works channel. The others should be at appropriate locations to determine general water levels in the downstream embankment. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential. The outlet works channel should be graded to provide positive drainage. Continue to observe wet areas and seepage downstream from the embankment and in the spillway channel. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

(8) As part of the regular maintenance program, cut the brush on the downstream slope, and fill the hole at the downstream toe.

In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Dunmore No. 1 Dam. A similar system is being recommended in other reports for Marshwood and Dunmore No. 3 Dams.

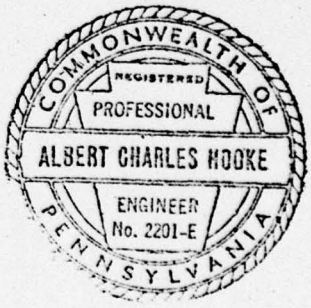
(2) Provide round-the-clock surveillance of Dunmore No. 1 Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

In addition, it is recommended that the Commonwealth of Pennsylvania require that the owner(s) of the culverts downstream from the dam perform a study to determine the effects of the culverts on the safety of the dam and that the owners be required to perform necessary remedial work if the culverts are found to affect the safety of the dam.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



A. C. HOOKE
Head, Dam Section

Date: 9 March 1979

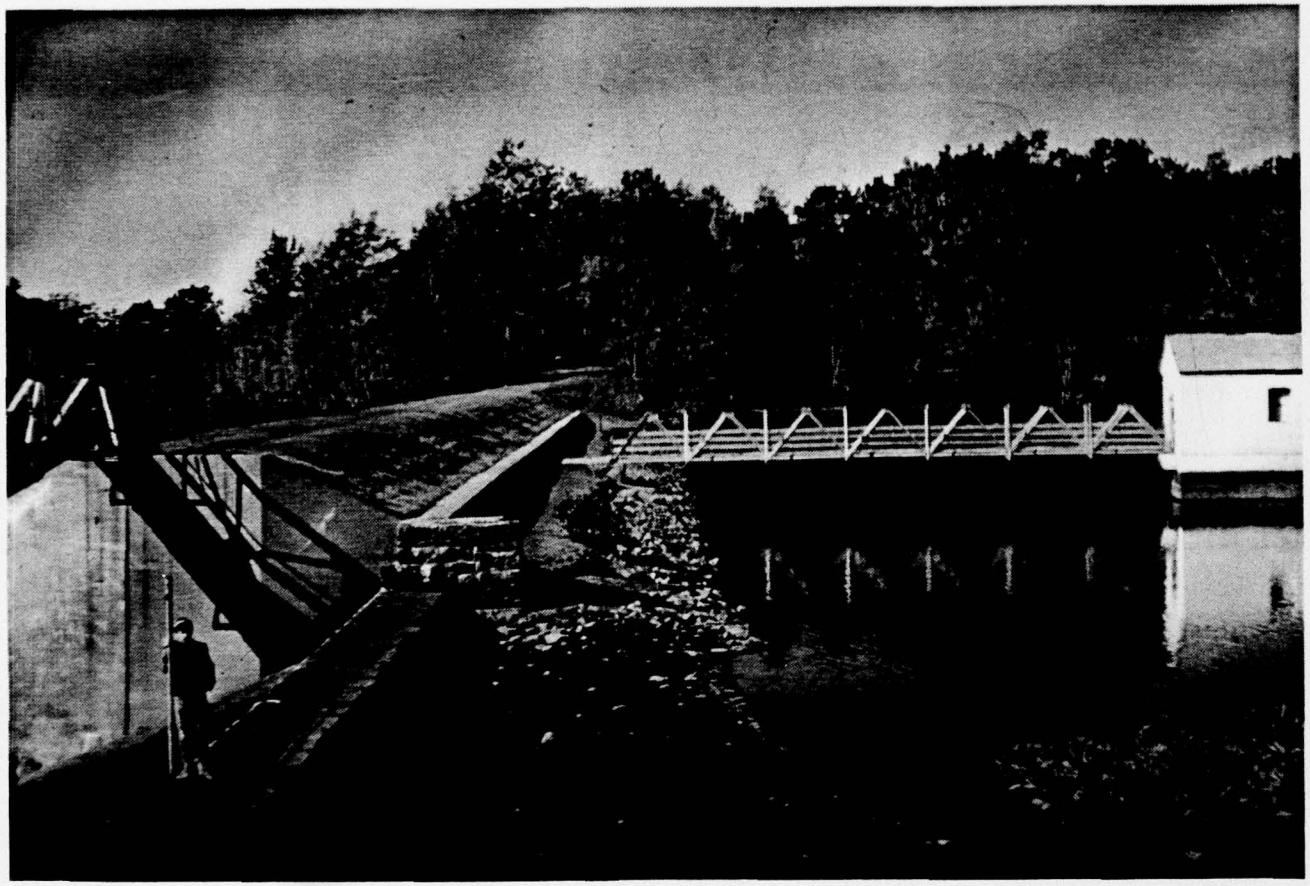
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 22 Mar 79

DUNMORE NO. 1 DAM



Overview

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Dunmore No. 1 Dam is a homogeneous earthfill embankment with a masonry core-wall, which extends to 5 feet below the top of the dam. A masonry gravity spillway is located at the left

abutment. The embankment is 400 feet long and 47 feet high at maximum section. The left end of the embankment is retained by a concrete gravity wall that also acts as the right spillway training wall. The spillway has a crest length of 124 feet. The crest is 9.0 feet below the design top elevation of the dam. A concrete intake structure is located approximately at the upstream toe of the embankment. A bridge extends from the embankment to the intake structure which has sluice-gates and operators for the water supply lines. Water supply pipes extend from the intake structure to the downstream toe. The various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on Little Roaring Brook approximately 0.5 mile west of Dunmore, Pennsylvania. Dunmore No. 1 Dam is shown on USGS Quadrangle, Olyphant Pennsylvania, with coordinates N41°24'55" and W75°35'55" in Lackawanna County, Pennsylvania. Marshwood Dam is 2.2 miles upstream of Dunmore No. 1 Dam. Dunmore No. 3 and No. 4 Dams are both about 1.4 miles upstream of Marshwood Dam. A location map is shown on Plate 1.

c. Size Classification. Intermediate (47 feet high, 603 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Dunmore No. 1 Dam (Paragraph 5.1c.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Water supply for Dunmore, Dickson City and surrounding communities in Pennsylvania.

g. Design and Construction History. The dam was originally a rock-filled timber crib structure, which was about 19 feet high, built in 1877. In 1891 the dam was reconstructed by the Burke Brothers, Contractors, under the supervision of J. B. Smith, superintendant of the Pennsylvania Coal Company, who was the original

owner. This reconstruction consisted of building a rubble masonry wall that was 30 feet high immediately downstream of the timber cribbing. In 1900, the spillway crest length was increased from 50.5 feet to 70 feet. In 1901 the dam was acquired by the Dunmore Gas and Water Company, the present owner under another name. At that time the masonry wall was raised 4 feet and earthfill was added upstream. In 1903, the spillway was again lengthened to a total length of 94 feet. The dam had previously overtopped in 1902. In 1908, the concrete intake structure was constructed.

The dam was inspected in 1914 by the Pennsylvania Water Supply Commission. The resulting report recommended that the spillway capacity be increased and that earthfill be placed against the downstream face of the masonry gravity section to provide better structural stability. Other recommendations not pertinent to the present structure were also forthcoming.

In 1916, the Owner implemented these recommendations by raising the masonry gravity wall about 2.5 feet and placing earthfill along the downstream face to an elevation 12.5 feet below the new top elevation of the wall.

In 1947 major modifications were made to the dam. The spillway crest was lengthened to its present length of 124 feet. The downstream earthfill was raised to its present configuration; thus the old masonry wall became a core-wall. The pipes under the dam were also modified.

The dam is evaluated in its present (post-1947) condition. Data not relevant to this condition have been omitted from this report.

h. Normal Operational Procedure. The pool is maintained at spillway crest with excess inflow discharged over the spillway. Water is drawn directly from the reservoir for water supply.

1.3 Pertinent Data.

a.	Drainage Area.[1] (square miles)	4.5
b.	Discharge at Damsite. (cfs.)	
	Maximum known flood at damsite	unknown
	Outlet works at maximum pool elevation	No Outlet works
	Spillway capacity at maximum pool elevation	8,830 (existing conditions)
	Spillway capacity at maximum pool elevation	9,600 (design conditions)
c.	Elevation. (Feet above msl.)	
	Top of dam (design)	1221.2
	Top of dam (existing)	1220.8
	Maximum pool	1220.8
	Normal pool	1212.2
	Upstream invert outlet works	None
	Downstream invert outlet works	None
	Streambed at Toe of dam	1174
d.	Reservoir Length. (Miles.)	
	Normal pool	0.33
	Maximum pool	0.46
e.	Storage. (Acre-feet.)	
	Normal pool (spillway crest)	230
	Maximum pool (design top of dam)	603

[1] See Section 5 for a discussion of the drainage area.

f.	Reservoir Surface. (Acres.)	
	Normal pool (spillway crest)	23
	Maximum pool (design top of dam)	59
g.	Dam	
	Type	Earthfill with masonry core-wall that extends to 5 feet from top of dam.
	Length (feet)	400
	Height (feet)	47
	Top Width (feet)	15
	Side Slopes - Upstream	Above El. 1216 - 1V on 2H Below El. 1213 - 1V on 2.3H (approximate) 8-foot wide berm and top of core-wall between El. 1213.0 and 1216.0
	Downstream	1V on 2H (design) 5-foot wide berm at El. 1201.0 The existing slope below the berm is 1V on 2.4H.
	Zoning	Homogeneous earthfill.
	Cutoff	Core-wall
	Grout Curtain	None
h.	Diversion and Regulating Tunnel.	None

i. Spillway.

Type	Masonry gravity section with inclined top
Length of Weir (feet)	124
Crest Elevation	1212.2
Upstream Channel	Reservoir
Downstream Channel	Variable bottom width channel, mostly in bedrock, with a concrete gravity wall on the right.

j. Regulating Outlets

Type	None except water supply pipes.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data were available for review for the structure as originally designed. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared for the components of the dam from interviews with the Owner, visual inspection, and other sources. The data in the report is limited. The 1914 study also included analyses for hydrology and hydraulics and structural stability. A summary of the results of the analyses is on file. Some engineering data for subsequent modifications were available for review. The construction specifications for the 1947 modifications were available.

b. Design Features. The project is described in Paragraph 1.2g. The various features of the dam are shown on Plate 2 and on the Photographs in Appendix D. Plates 2 and 5 show the general arrangement of the dam. Plate 2 also shows the treatment given the pipes that were beneath the dam before the 1947 modifications were accomplished. The embankment is shown on Plate 3 and on Photographs A, B, and E. The right spillway training wall and the spillway are shown on Plate 4 and Photographs C, D, and F. These plates were originally drawn for the 1947 modification. The dam, as it existed before 1947, is shown on some of the plates. Plate 5 is an as-built drawing showing some modifications apparently made during construction.

c. Design Considerations. The bridge at the downstream end of the spillway channel (Photograph D) is obviously undersized; this is addressed in Section 5. The various reports by the Commonwealth noted that the structural stability of the masonry wall was of concern. This wall was later modified in 1947 to become the present spillway.

2.2 Construction.

a. Data Available. Construction data for the original structure that are available for review, consists of the information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. Information in the 1914 report is very limited. Foundation conditions encountered during the 1891 modification to the dam are noted in Appendix E.

b. Construction Consideration. Since the available construction data is limited, construction methods cannot be assessed.

2.3 Operation. There are no formal records of operation. The Owner did not report any problems having occurred over the operational history of the dam, since its latest modifications.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer for information. He also researched his files for additional data at the request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The overall appearance of the dam is good. However, some deficiencies were observed as noted below. A sketch of the dam with the location of some deficiencies is presented in Appendix B on Plate B-1. Survey information acquired for this report is summarized in Appendix B. On the day of the inspection, the pool was 3.9 feet below the spillway crest.

b. Embankment. The embankment is in generally good condition. The top of the embankment is at or above design elevation except for an area immediately adjacent to the right spillway wall, which is 0.4 foot below the design elevation. The slopes are in accordance with the sections shown on Plate 3, except the lower downstream slope is 1V on 2.4H, which is flatter than the design slope of 1V on 2H. Below the berm at Elevation 1201.0, riprap covers the downstream slope from the right abutment to about the middle of the embankment. This riprap has a sporadic cover of low brush. (Photograph A) The remainder of the downstream slope, the top, and the upstream slope above Elevation 1216.0 are covered with grass. The grass is in excellent condition except for three relatively small bare areas. These areas appear like very shallow sloughs, but no evidence of soil movement was observed. There are ruts, of minor depth, near the spillway bridge. There is riprap on the upstream slope below Elevation 1213.0. The riprap is poorly graded, with clusters of large and small stones. There is a bare area on the riprap to the left of the spillway bridge (Photograph E). The riprap does not extend all the way to the right abutment. Also, the riprap does not extend to the top of the dam. The top of the riprap is at Elevation 1213.0 or 8.2 feet below design top of the dam.

There is a hole about 2 feet deep directly at the toe of the embankment. The masonry core-wall has a 2.67-foot concrete cap. The concrete is peeling in many areas (Photograph E).

c. Appurtenant Structures. The spillway is in generally good condition (Photograph C). The mortar in the masonry spillway joints is slightly deteriorated. The bottom of the spillway outlet channel is mostly bedrock (Photograph D). Many small seeps were observed coming through the rock. There is a small dry masonry wall along a short reach at the left. The right side of the channel is a concrete gravity wall which retains the embankment and also acts as a training wall. The wall is slightly spalled at the top. Pattern cracking and leaching were observed at one monolith (Photograph F). The spillway channel narrows and passes under a small bridge that provides access to the toe of the embankment (Photograph D). The dimensions of the bridge are presented in Appendix C.

The Owner stated that there was no operational outlet works, except for the water supply pipes. The old outlet works channel was observed. This channel is overgrown and is ponded with water. Clear seepage in the channel of about 5 gpm was observed. It was not possible to determine its source. The channel appeared to be blocked, with no visible outlet. A 18-inch diameter cast-iron pipe, about 1/2 full of debris, was observed at the edge of the channel.

The intake structure has sluice gates to provide upstream closure for the water supply lines. Their operation was not viewed on the day of the inspection.

d. Reservoir Area. Most of the watershed is steep and wooded. All of it is undeveloped and uninhabited. It is owned and controlled by the Pennsylvania Gas and Water Company. All the dams upstream of Dunmore No. 1 Dam were visited during the week of the inspection.

e. Downstream Conditions. The spillway channel proceeds downstream for 400 feet, where it passes through a culvert under a local road (Photograph G). Within 100 feet of the outfall, the stream enters a culvert which passes under Interstate 380 (Photograph H). The dimensions of the culverts are given in Appendix C. The stream then proceeds directly through a part of Dunmore. Dwellings are located close to the low stream banks. Both the local road and Interstate 380 extend

approximately parallel to the axis of the dam. The local road is about 12 feet below spillway crest elevation. Interstate 380 is above the top elevation of the dam at the left side of the valley. Going from left to right, the interstate grades down and it is below the top elevation of the dam at the right side of the valley. It then merges into an interchange with Interstate 81. An underpass below Interstate 380 is at the left side of the valley.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, Elevation 1212.2, with excess inflow discharging over the spillway and into Little Roaring Brook. Water supply lines at the dam are connected directly to the Owner's distribution system. There is no outlet works pipe to release water from the reservoir into the stream below.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who records the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is used by the Owner's Engineering Department for regulating flows in the distribution system. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. The water supply line valves are operated frequently. In response to the National Dam Inspection Program of the previous year, the Owner is in the process of modifying his maintenance procedures. Details of the program have not been fully formulated.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command diagram for Dunmore No. 1 Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering

Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Dunmore No. 1 Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation Of Operational Adequacy. The operational procedures appear satisfactory. There is no emergency drawdown line, which is considered a serious deficiency. The maintenance of the embankment is good. The procedures used by the Owner for inspecting the dam are adequate, but some needed repairs have not been made. In general, the warning system is adequate, but it would be more effective if it were more detailed.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. In a report prepared by Thomas H. Wiggin, consulting engineer of New York City, a spillway capacity of 11,000 cfs was estimated for the 1947 modification. The Commonwealth prepared a report upon the application of the Owner, prior to issuing a permit for the 1947 modifications to the dam. In that report, they estimated the design spillway capacity at 10,000 cfs. A design discharge of 9,600 cfs was used for this study, as will be explained hereinafter. There is other data pertaining to the spillway before the 1947 modification. However, it is not relevant to the existing condition.

b. Experience Data. No hydraulic or hydrologic problems were reported by the Owner since the 1947 modifications to the dam. He stated that there were no records of maximum pool levels.

c. Visual Observations

(1) General. The visual inspection of Dunmore No. 1 Dam, which is described in Section 3, resulted in a number of observations relevant to hydraulics and hydrology. These observations are evaluated herein for the various features.

(2) Embankment. The low area at the top of the embankment reduces the spillway capacity. The training wall was apparently constructed with its top below the design elevation, because the top of the wall is at the same elevation as the low area. At present, the riprap on the upstream slope is inadequate. The poor gradation has resulted in a washout at the bare area. Apparently, there is little protection provided by it. For substantial spillway flows, there will be cross-flow. Not providing riprap on the upper part of the upstream slope is an erosion hazard. The riprap on the downstream slope is evaluated with the downstream conditions.

(3) Appurtenant Structures. The potential for cross-flow at the spillway is noted above. The spillway capacity is evaluated with the downstream conditions.

Although the water supply lines may provide some drawdown capability, the lack of a regular emergency drawdown facility is considered a serious deficiency. The pipe observed at the outlet channel may be an emergency drawdown facility. The Owner stated that there was no such facility. The condition at the end of the pipe indicates that it has not been operated for some time.

(4) Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam. The assessment of the dam is based on existing conditions and the effects of future development are not considered.

Phase I reports for the National Dam Inspection Program are being prepared concurrently for Marshwood Dam and Dunmore No. 3 Dam, both of which are upstream of Dunmore No. 1 Dam. Both these dams are of small size and categorized as high hazard. Dunmore No. 4 Dam, which is upstream of Marshwood Dam, is evaluated in the report for Marshwood Dam. The failure of any of the upstream dams would probably cause the failure of Dunmore No. 1 Dam, if a substantial amount of runoff were occuring over the Dunmore No. 1 watershed.

(5) Downstream Conditions. As indicated by the calculations in Appendix C, the peak spillway discharge cannot pass under the bridge that is located at the toe of the dam. The bridge would overtop, presenting an erosion hazard to the toe of the embankment. The available drawings note that the fill to the left of the bridge was loosely placed. It may have been the intent to allow this fill to erode during substantial spillway flows. This would alleviate the situation, but the bridge would still overtop for larger spillway flows. It appears that it would have been better to

extend the rockfill on the downstream slope of the embankment across the entire slope. Backwater effects from the bridge overtopping will not reduce the spillway discharge capacity.

The backwater effect from the two culverts downstream from the dam will probably reduce the spillway capacity. The flooding pattern downstream from the dam is very complex. It appears that flooding would occur in Dunmore before the culverts were flowing full. As noted in the computations in Appendix C, the culverts will develop pressure flow at a much lower discharge than the spillway capacity of the dam. At discharges below spillway capacity, water will commence to discharge through the underpass at the left side of the valley. At higher stages, water will then begin to discharge over Interstate 380, near its interchange with Interstate 81. The computations indicate that a significant backwater effect will occur at the spillway. The spillway capacity will be reduced by 4 percent. This reduction in spillway capacity is reflected in the 9,600 cfs used for this study. It must be emphasized that these computations were based on estimated elevations. The actual effects could reduce the spillway capacity by a much greater percentage.

Part of the reason for the undersized culverts is inaccurate USGS mapping in the area. The USGS maps do not show Marshwood Dam draining into Little Roaring Brook. A letter in the PennDER files indicates that the culvert under Interstate 380 was designed by PennDOT using the drainage area obtained from the USGS maps. The computed drainage area is about 60 percent of the actual drainage area.

Downstream conditions indicate that a high hazard classification is warranted for Dunmore No. 1 Dam. Access to the dam is via the underpass at the left side of the valley. Access to the dam is excellent until the underpass is flooded.

d. Overtopping Potential

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of

Engineers (OCE), the spillway design flood (SDF) for the size (Intermediate) and hazard potential (High) of Dunmore No. 1 Dam is the probable maximum flood (PMF).

(2) Description of Model. The watershed was modelled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure.

The PMF inflow component to both Dunmore No. 3 and Dunmore No. 4 Dams was computed and routed through the dams. The outflows were routed downstream and combined. This combined flow was routed further downstream and was added to the uncontrolled PMF inflow component to Marshwood Dam. The combined flow was routed through Marshwood Dam and downstream to Dunmore No. 1 Reservoir, where it was combined with the uncontrolled PMF inflow component to Dunmore No. 1 Dam. The combined flow was routed through Dunmore No. 1 Dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C.

The analysis reveals that, with its existing low spot, Dunmore No. 1 Dam can pass about 84 percent of the PMF without overtopping. If the dam were raised to its design elevation, it could pass about 90 percent of the PMF without overtopping.

(4) Spillway Adequacy. The criteria for rating a spillway is presented in Appendix C. Since the dam cannot pass the PMF but it can pass the 1/2 PMF without overtopping, the spillway is rated as inadequate. If the dam were raised to its design elevation, the spillway would still be rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Dunmore No. 1 Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The wall at the left end of the embankment was apparently constructed with its top below the design elevation. This is the cause of the low area. Apparently, the construction plans were changed both to flatten the lower downstream slope and to provide riprap over the right end of this slope. As noted in Section 5, there is the possibility of high tailwater during periods of high spillway discharge. Extending the riprap across the entire slope would reduce the erosion potential. The riprap on the upstream slope is addressed in Section 5. The Owner reports that the hole at the toe of the embankment was caused by neglecting to backfill after an old valve was removed. The valve was attached to one of the abandoned pipes shown on Plate 2. It would be better practice to backfill such areas. The deterioration of the concrete core-wall cap is probably caused by exposure to the weather.

(3) Appurtenant Structures. The deteriorated mortar in the masonry spillway joints is probably caused by exposure to flowing water. The deterioration is not severe. The seepage from the cracks in the bedrock in the bottom of the spillway channel is not excessive.

The spalling along the top of the spillway training wall is probably caused by long term exposure to the elements. The cause of the cracking and leaching on one of the monoliths of this wall is unknown, but it may be related to overfinishing of the concrete. Although it is not severe at present, further cracking would be of concern.

The source of the seepage in the outlet works channel could not be determined. Judging by the seepage in the spillway channel, the seepage in the outlet works channel may be from the underlying bedrock.

b. Design and Construction Data. No record of design data or stability analyses were available for review. Analysis of the embankment stability is beyond the scope of this study. Also, sufficient data on the engineering properties of the embankment material would have to be acquired before the analysis could be performed. No evidence of stability problems presently threatening the embankment were observed.

No analysis of stability for either the spillway in its present condition or the spillway right training wall was available for review. In the 1914 Report by the Pennsylvania Water Supply Commission, an analysis of a section similar to the existing spillway indicated that the resultant was outside the middle third, with uplifts neglected and assuming the soil pressure on the upstream face was 2/3 of the hydrostatic pressure on the upstream face.

For this study two stability analyses were performed. The spillway concrete gravity right training wall was analyzed assuming no tailwater, a water level in the embankment 3 feet below the embankment surface, and uplift varying from zero at the toe to 2/3 full hydrostatic pressure at the heel. For this loading condition, the resultant is outside the middle third but within the base, about 1.8 feet from the toe; the factor of safety against sliding and the toe pressure are adequate. Although OCE guidelines state that the resultant should be within the middle third, the location of the resultant is not deemed to be a significant deviation from the guidelines.

The stability of the spillway section was also analyzed for this study. Only the highest section was considered and the stability was checked at its base. It was assumed that: headwater was at the 1/2 PMF level, tailwater was 6 feet above the toe, full hydrostatic head and at-rest earth pressure was on the upstream face, and uplift was varying from full tailwater at the toe to full tailwater plus two-thirds the difference between headwater and tailwater at the heel. For this loading condition, with the pool at 1/2 PMF level, the resultant is about 6.6 feet outside the base. There are mitigating conditions at the spillway. An analysis of the same section, using similar methodology but assuming the reservoir at spillway crest elevation and no tailwater, indicates the resultant is 1.9 feet outside that base. Since it is apparent that the resultant cannot be outside the base for this condition, the analysis is not totally valid. The highest section extends for only 15 feet across the valley. The right end abuts the concrete gravity spillway training wall that is noted above. There is a reinforced and anchored concrete buttress about 40 feet from the right end. This length of spillway is therefore a buttress section. An analysis of a buttress section is beyond the scope of this study. Until the buttress section is analyzed, its structural stability is in doubt.

c. Operating Records. There are no formal records of operation. No evidence of instability on any feature of the dam has been noted.

d. Postconstruction Changes. As noted herein, there is sufficient information available on all modifications made to Dunmore No. 1 Dam, such that its stability can be assessed.

e. Seismic Stability. Dunmore No. 1 Dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, and there is the potential of earthquake forces moving or cracking the masonry core-wall, the theoretical seismic stability of Dunmore No. 1 Dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, Dunmore No. 1 Dam is judged to be in good condition. The existing spillway will pass 84 percent of the PMF without overtopping of the dam. The spillway is rated as inadequate.

If the embankment were raised to its design elevation, the dam could pass 90 percent of the PMF. The spillway still would be rated as inadequate.

Two culverts under a local road and under Interstate 380 may provide significant tailwater effects at the dam that reduces the spillway capacity.

(2) There is no evidence of serious stability problems at the embankment. The concrete gravity spillway training wall, which retains the embankment, has a resultant outside the middle third but within the base for the maximum loading conditions. This is not considered to be a significant deviation from the OCE guidelines.

The stability of the masonry gravity spillway section, which acts as a buttress section, is unknown without further analysis.

(3) There is no emergency drawdown facility.

(4) The visual inspection resulted in some deficiencies, which are summarized below for the various features.

Feature and Location	Observed Deficiency
Embankment:	
Top Upstream Slope	Low Area Inadequate and washed out riprap not extending to the top of the dam
Downstream slope	Hole, erosion hazard from tailwater, brush
Core-Wall	Deteriorated concrete cap
Spillway:	
Weir	Deteriorated mortar
Right training wall	Spalled and pattern cracking, seepage
Channel	Constricted at downstream end by a bridge.
Outlet Works:	
Streambed	Seepage

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform a study to determine if the spillway is structurally adequate and to perform remedial measures as required.

(2) Raise the embankment to its design elevation.

(3) Perform additional studies to determine the emergency drawdown capabilities of the water supply line(s). If these capabilities are inadequate, an emergency drawdown facility should be provided.

(4) Repair or replace the existing riprap on the upstream slope and extend it to the top of the dam. Extend the riprap on the downstream slope across the entire embankment.

(5) Perform additional studies to determine the erosion hazard caused by the small bridge at the downstream end of the spillway channel. Take remedial action as needed.

(6) Visually monitor the spalling, cracking, and deterioration of the concrete and masonry joints. Take remedial action when needed.

(7) Install four or more observation wells, or other instrumentation, downstream of the axis of the embankment. One well, or other instrumentation, should be located in the vicinity of the seepage area in the outlet works channel. The others should be at appropriate locations to determine general water levels in the downstream embankment. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the structures and assessing piping potential. The outlet works channel should be graded to provide positive drainage. Continue to observe wet areas and seepage downstream from the embankment and in the spillway channel. If conditions worsen, appropriate action should be taken to control apparent seepage with properly designed drains.

(8) As part of the regular maintenance program, cut the brush on the downstream slope, and fill the hole at the downstream toe.

b. In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Dunmore No. 1 Dam. A similar system is being recommended in other reports for Marshwood and Dunmore No. 3 Dams.

(2) Provide round-the-clock surveillance of Dunmore No. 1 Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

c. In addition, it is recommended that the Commonwealth of Pennsylvania require that the owner(s) of the culverts downstream from the dam perform a study to determine the effects of the culverts on the safety of the dam and that the owners be required to perform necessary remedial work if the culverts are found to affect the safety of the dam.

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

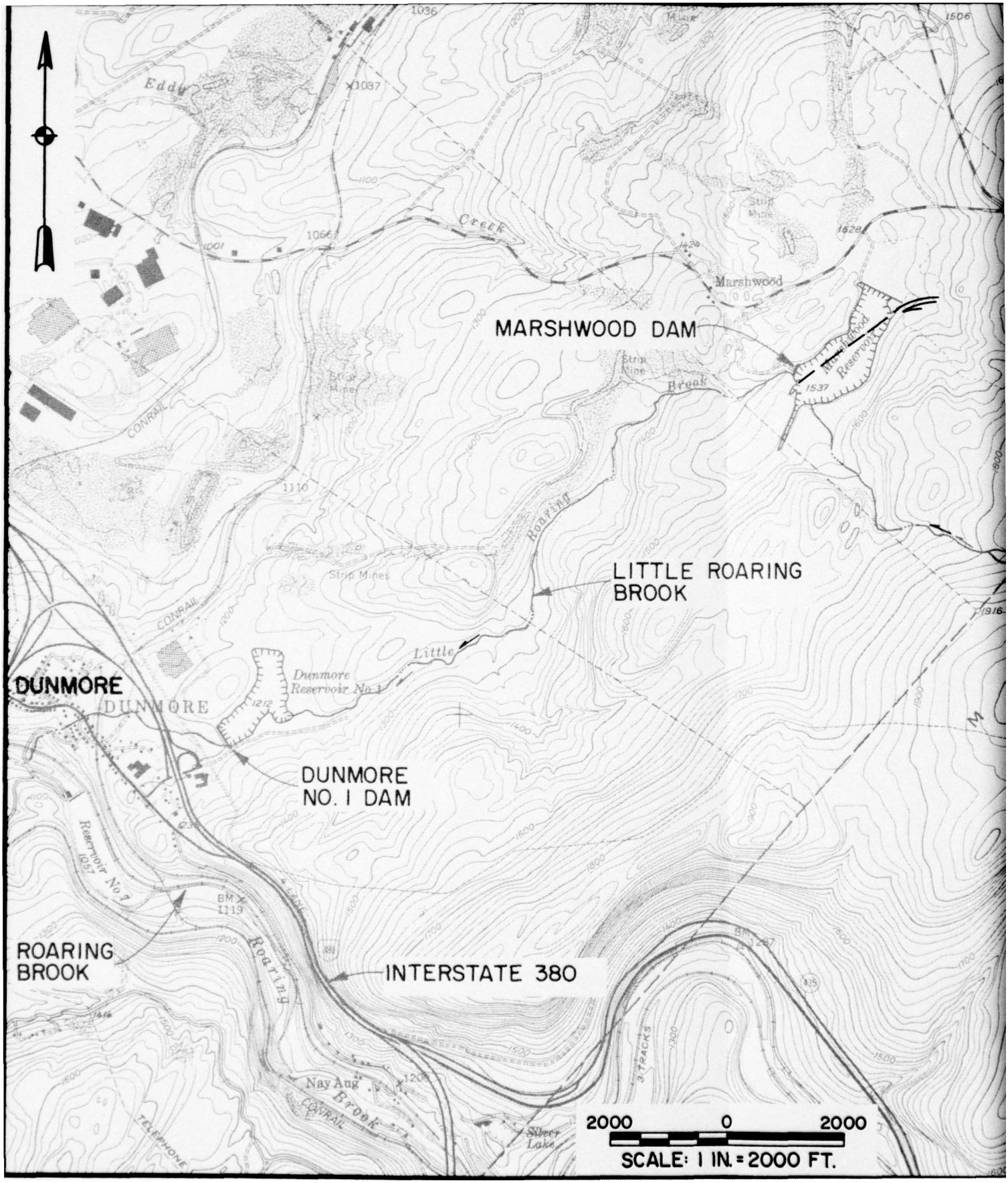
PENNSYLVANIA GAS AND WATER COMPANY

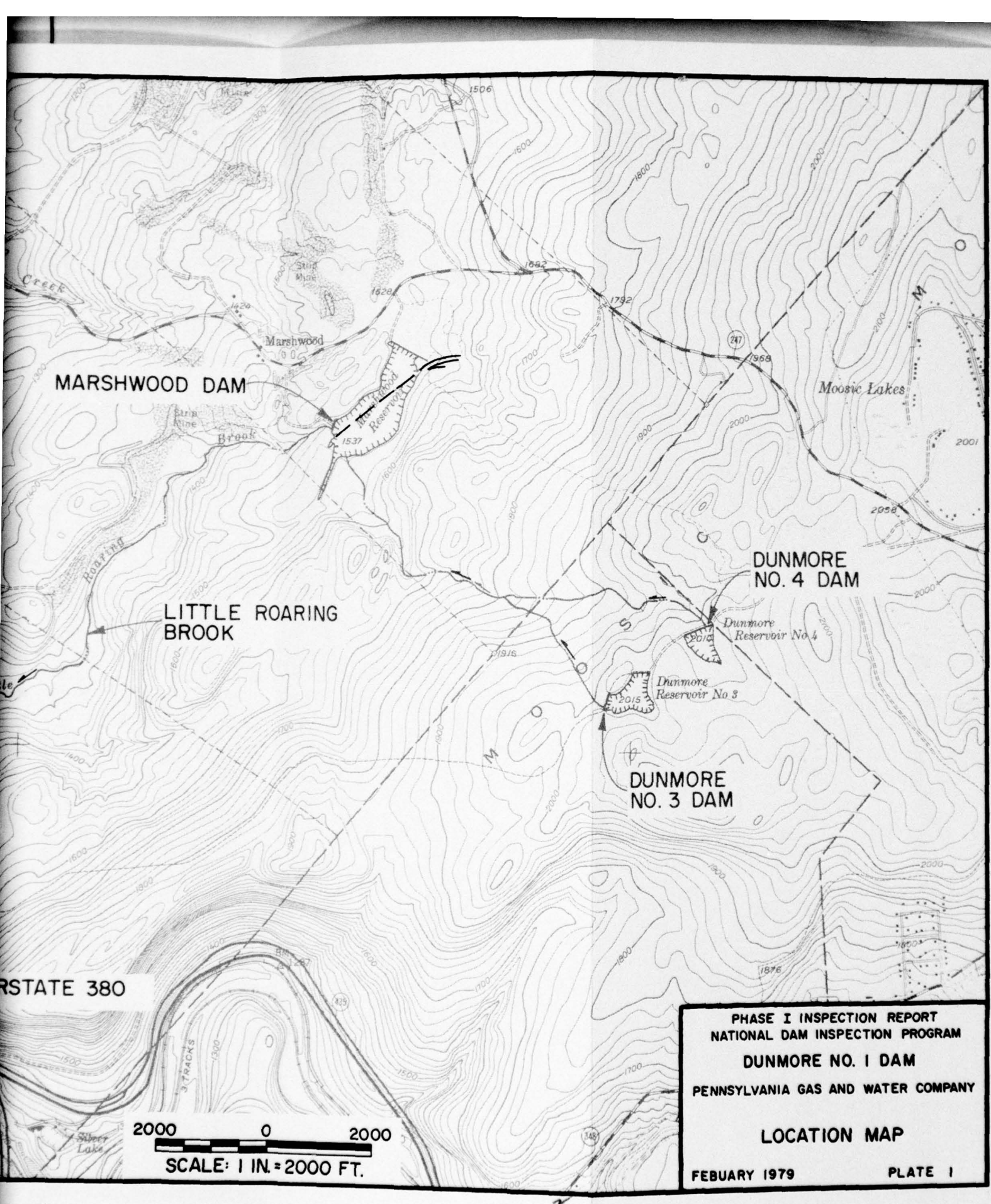
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

PLATES


MARSHWOOD DAM
LITTLE ROARING BROOK
DUNMORE
DUNMORE NO. 1 DAM
ROARING BROOK
INTERSTATE 380
Marshwood Reservoir
Dunmore Reservoir No. 1
Reservoir No. 7
Roaring Brook
Little Roaring Brook
Nay Aug Brook
Silver Lake
CONRAIL
3 TRACKS
4 LANE
TELEPHONE
2000 0 2000
SCALE: 1 IN. = 2000 FT.



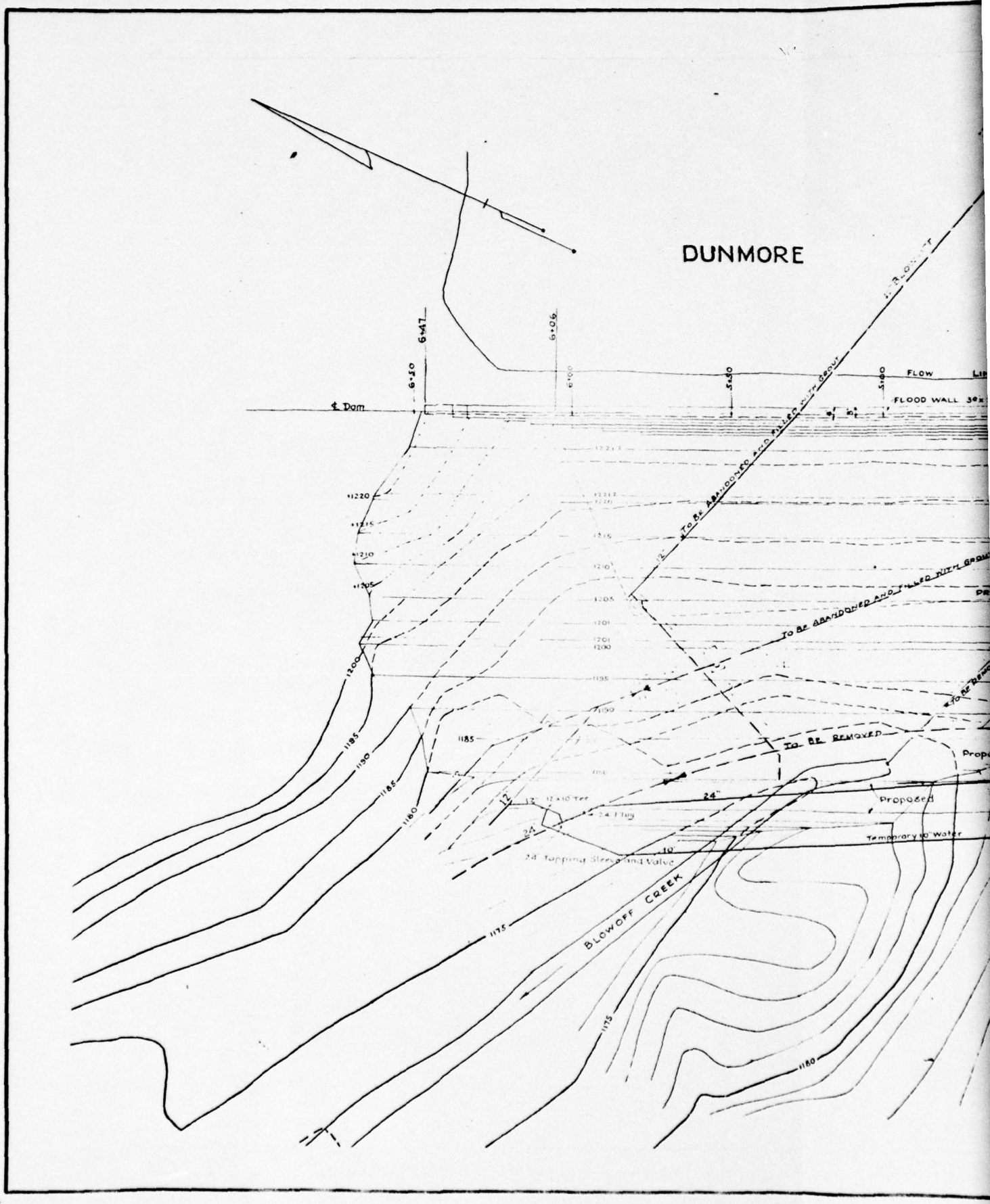
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

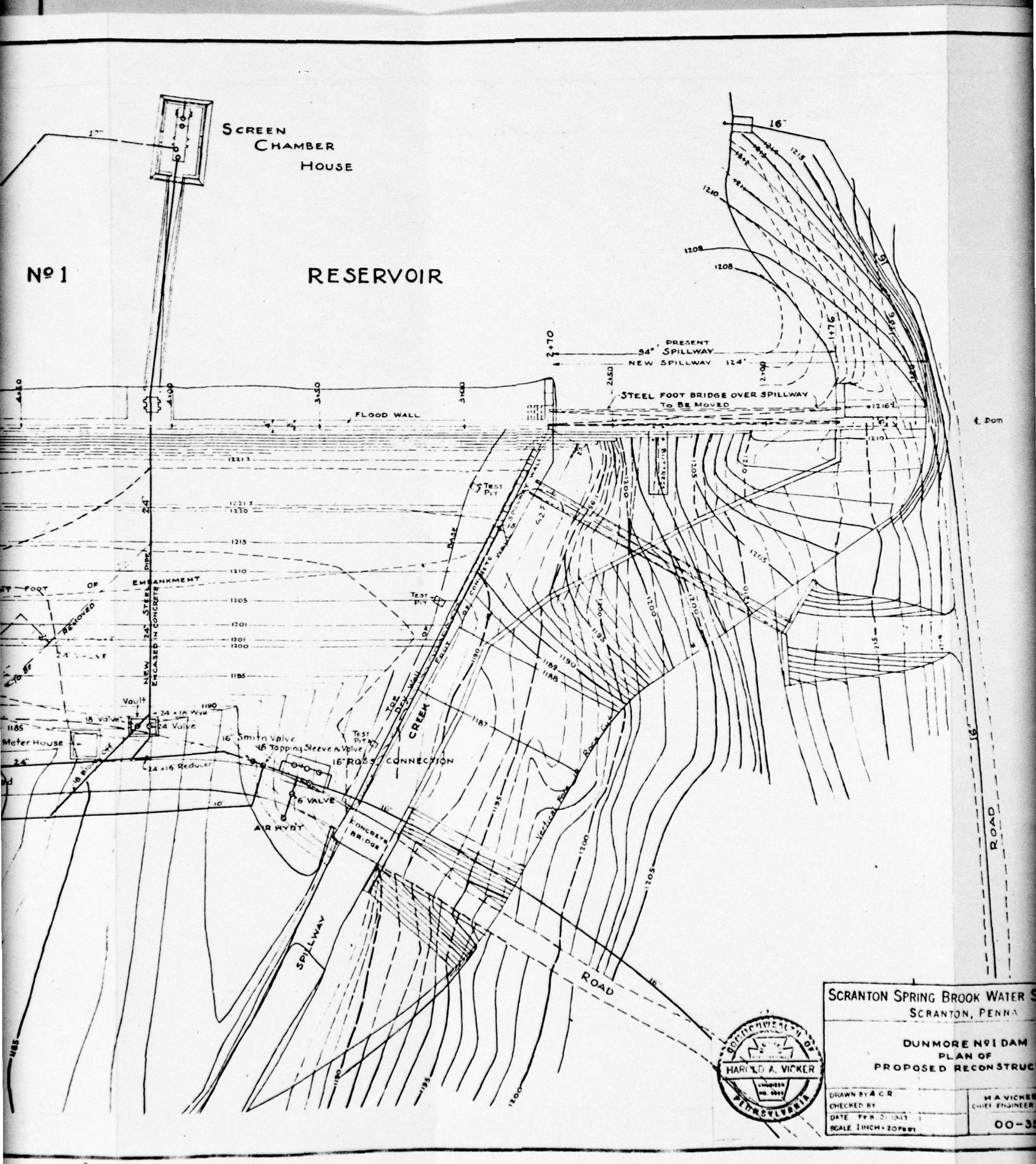
DUNMORE NO. 1 DAM

PENNSYLVANIA GAS AND WATER COMPANY

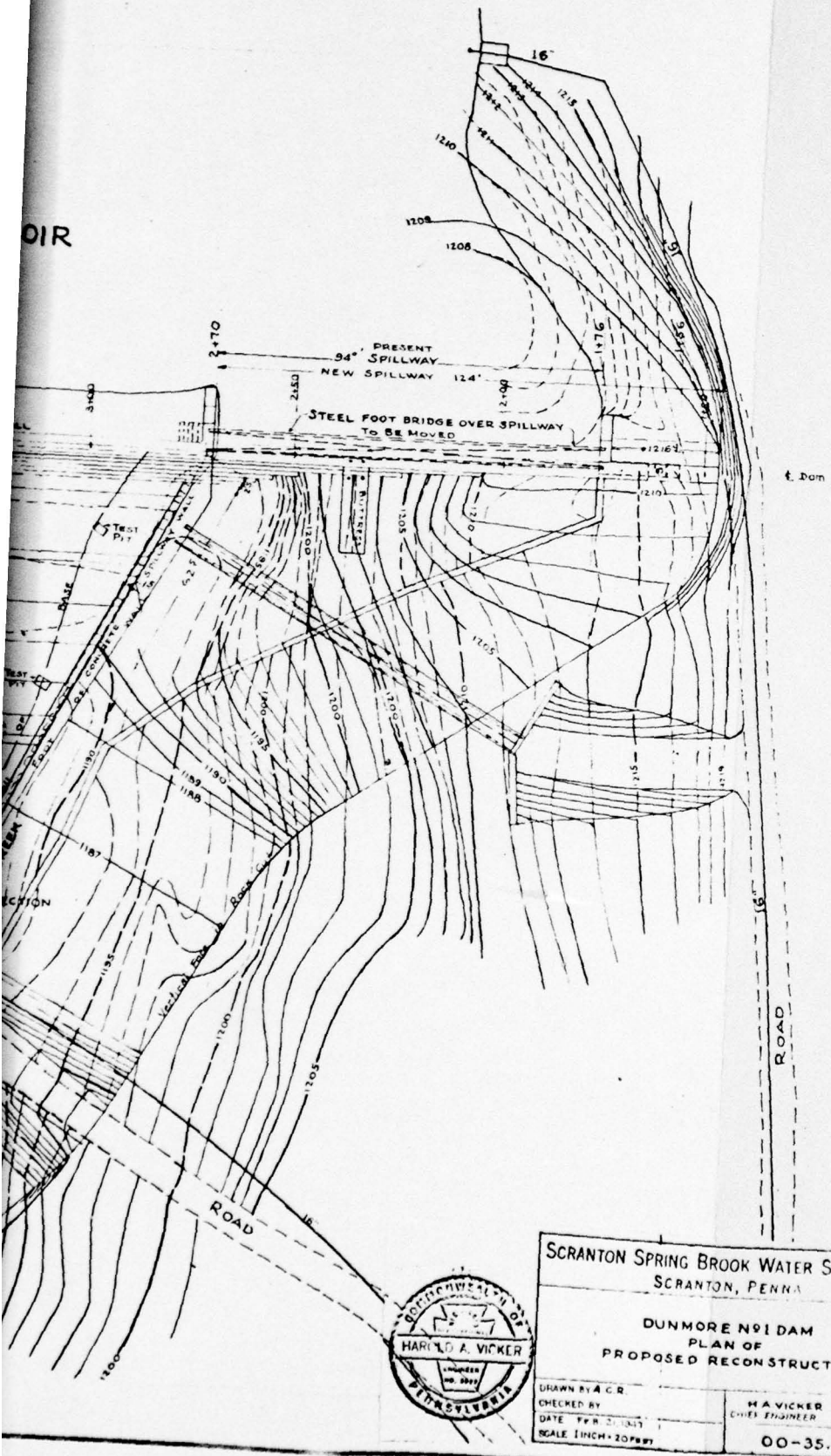
LOCATION MAP

FEBUARY 1979 PLATE 1


DUNMORE
6+50
6+47
6+06
5+50
5+00
FLOW
FLOOD WALL
℄ Dam
TO BE ABANDONED AND FILLED WITH GROUT
TO BE REMOVED
Proposed
Temporary 10" Water
12"x10" Tee
24" Plug
24" Tapping Sleeve and Valve
BLOWOFF CREEK
1220
1215
1210
1205
1200
1195
1190
1185
1180
1175



SCREEN CHAMBER HOUSE
Nº 1
RESERVOIR
PRESENT 94" SPILLWAY
NEW SPILLWAY 124'
STEEL FOOT BRIDGE OVER SPILLWAY TO BE MOVED
FLOOD WALL
FOOT OF EMBANKMENT
NEW 24" STEEL PIPE ENCASED IN CONCRETE
TEST PIT
Vault
18" Valve
24 x 18 Wye
24 Valve
Meter House
24 x 16 Reducer
16" Smith Valve
16 Tapping Sleeve & Valve
16" ROSS CONNECTION
6 VALVE
AIR HYDT
CONCRETE BRIDGE
CREEK
SPILLWAY
ROAD
℄ Dam
SCRANTON SPRING BROOK WATER S
SCRANTON, PENNA
DUNMORE Nº1 DAM
PLAN OF
PROPOSED RECONSTRUC
DRAWN BY A.C.R.
CHECKED BY
DATE
SCALE 1 INCH = 20 FEET
H A VICKER
CHIEF ENGINEER
00-35
HAROLD A. VICKER
COMMONWEALTH OF PENNSYLVANIA



SCRANTON SPRING BROOK WATER SERVICE CO.
SCRANTON, PENNA.

DUNMORE No 1 DAM
PLAN OF
PROPOSED RECONSTRUCTION

DRAWN BY A.C.R.
CHECKED BY
DATE FEB. 1979
SCALE 1 INCH = 20 FEET

H.A. VICKER
CHIEF ENGINEER

00-35.424

COMMONWEALTH OF PENNSYLVANIA
HAROLD A. VICKER
ENGINEER
NO. 6002

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

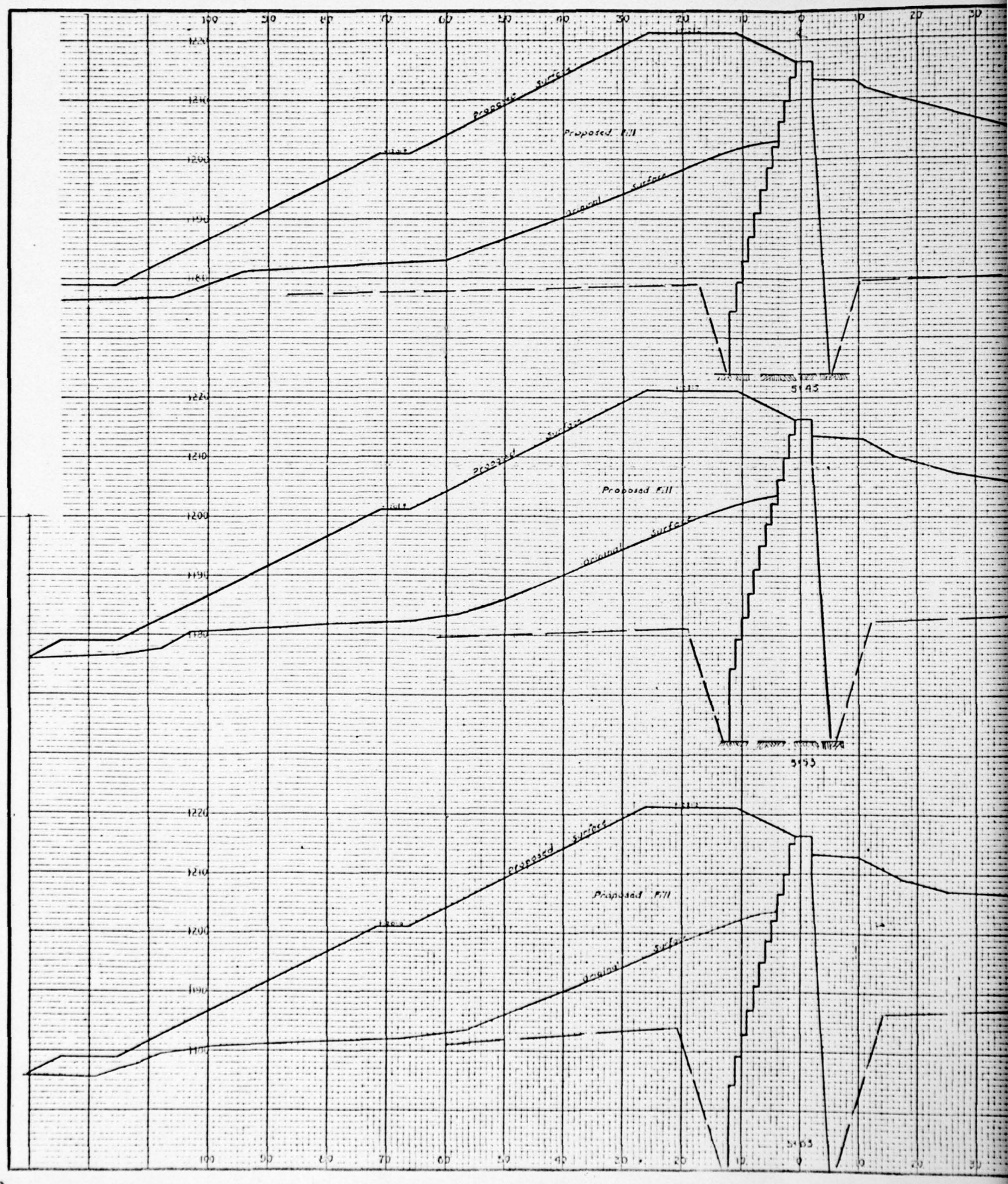
DUNMORE NO. 1 DAM

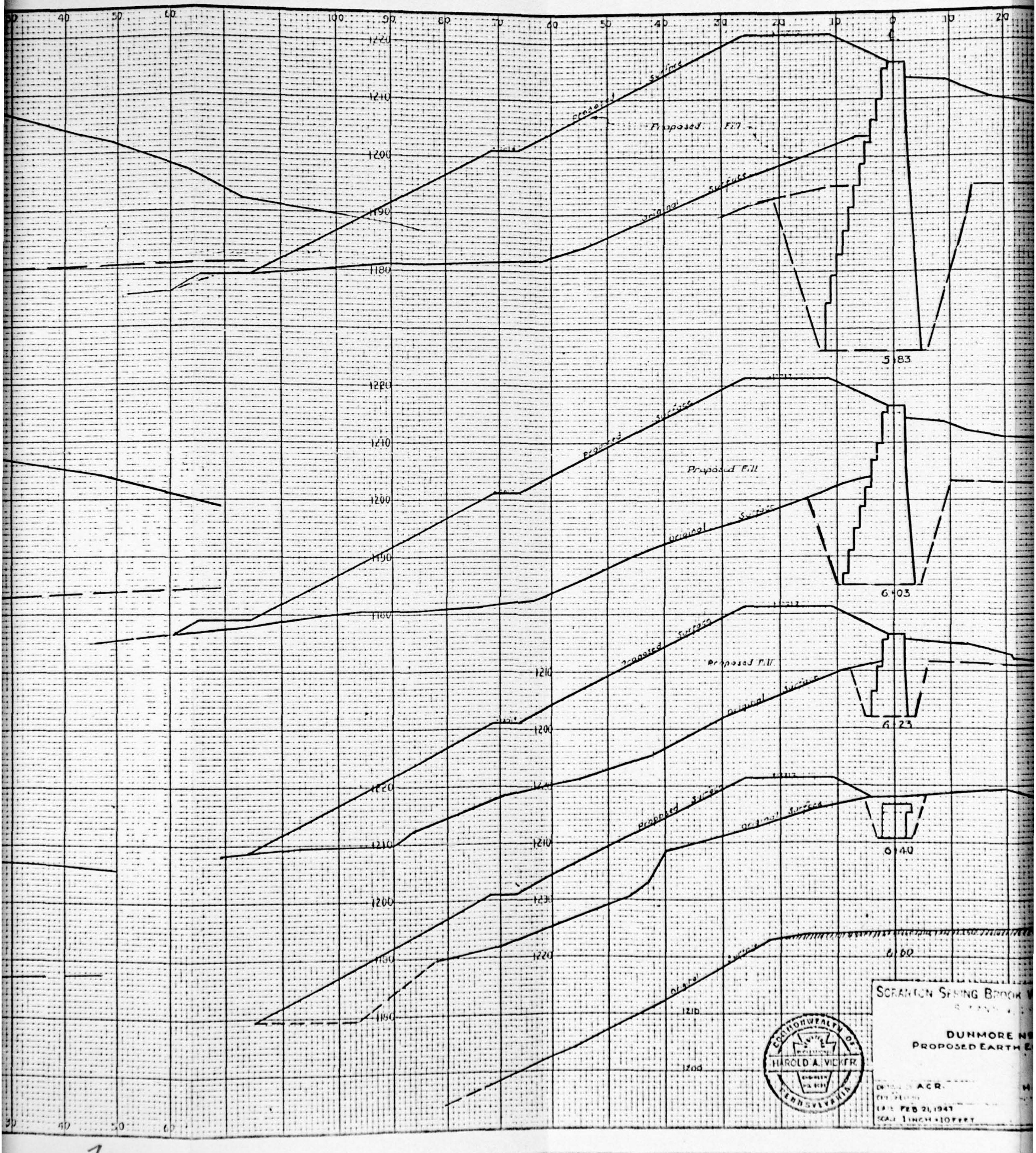
PENNSYLVANIA GAS AND WATER COMPANY

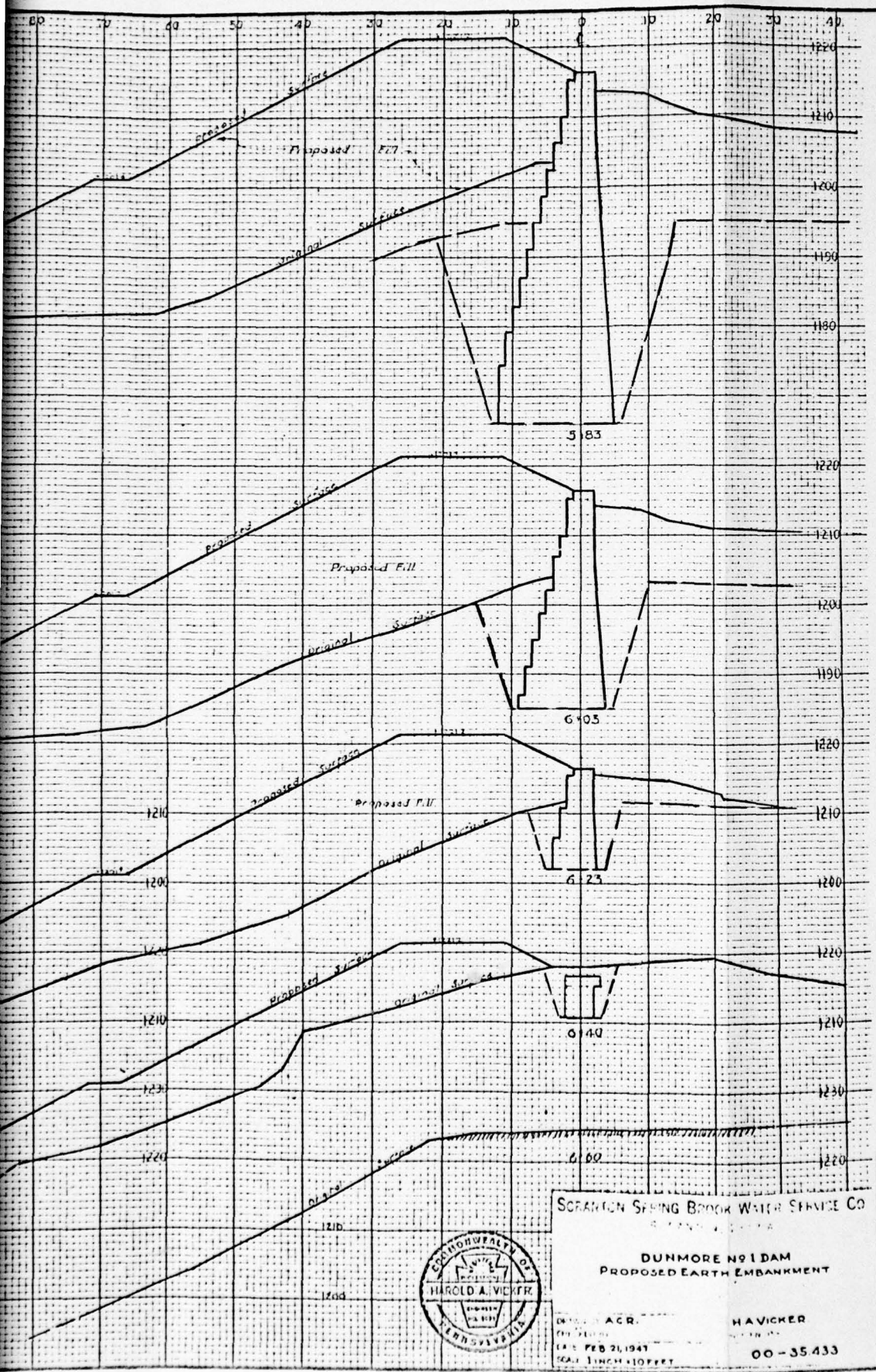
PLAN

FEBUARY 1979

PLATE 2


Proposed Fill
Original Surface
Proposed Fill
Original Surface
Proposed Fill
Original Surface


Proposed Surface
Proposed Fill
Original Surface
5+83
6+03
6+23
6+40
6+60
SCRANTON SPRING BROOK
DUNMORE
PROPOSED EARTH
COMMONWEALTH OF PENNSYLVANIA
HAROLD A. VICKER
ACR.
FEB 21, 1947
1 INCH = 10 FEET



SCRANTON SPRING BROOK WATER SERVICE CO

DUNMORE NO 1 DAM
PROPOSED EARTH EMBANKMENT

DRAWN A.G.R. H.A.VICKER

DATE FEB 21, 1941

SCALE 1 INCH = 10 FEET

00-35.433

COMMONWEALTH OF PENNSYLVANIA
HAROLD A. VICKER

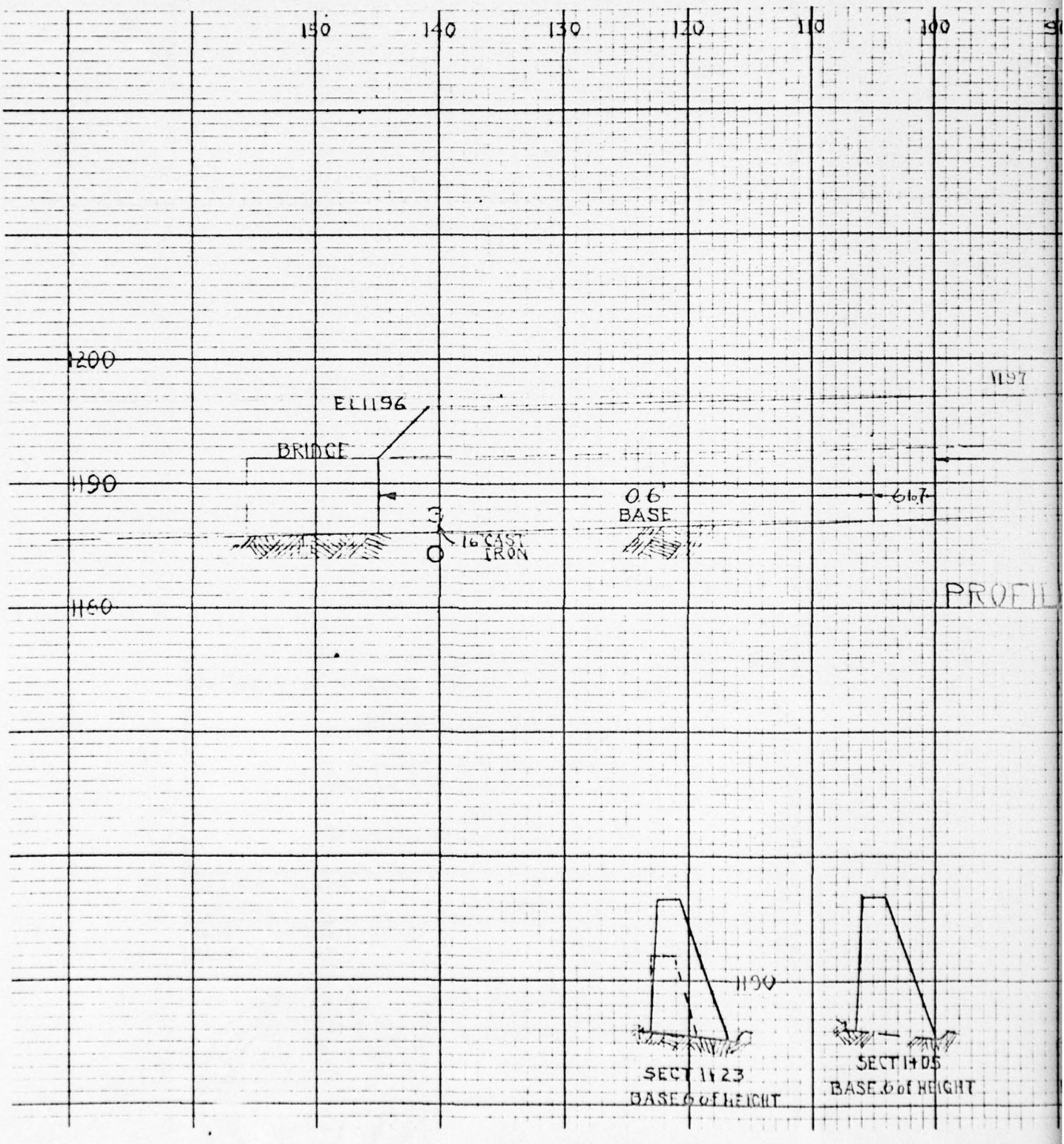
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

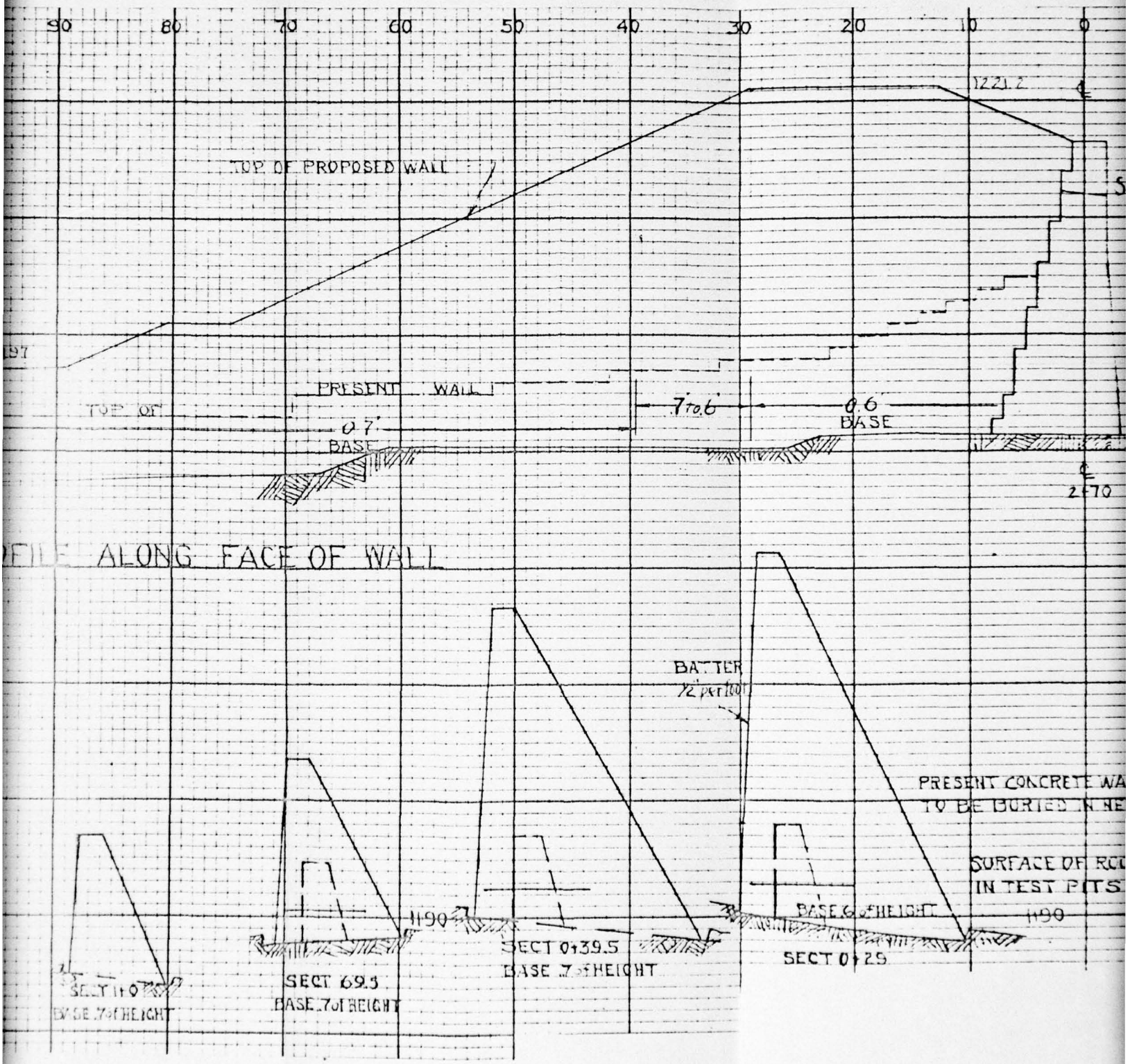
DUNMORE NO. 1 DAM

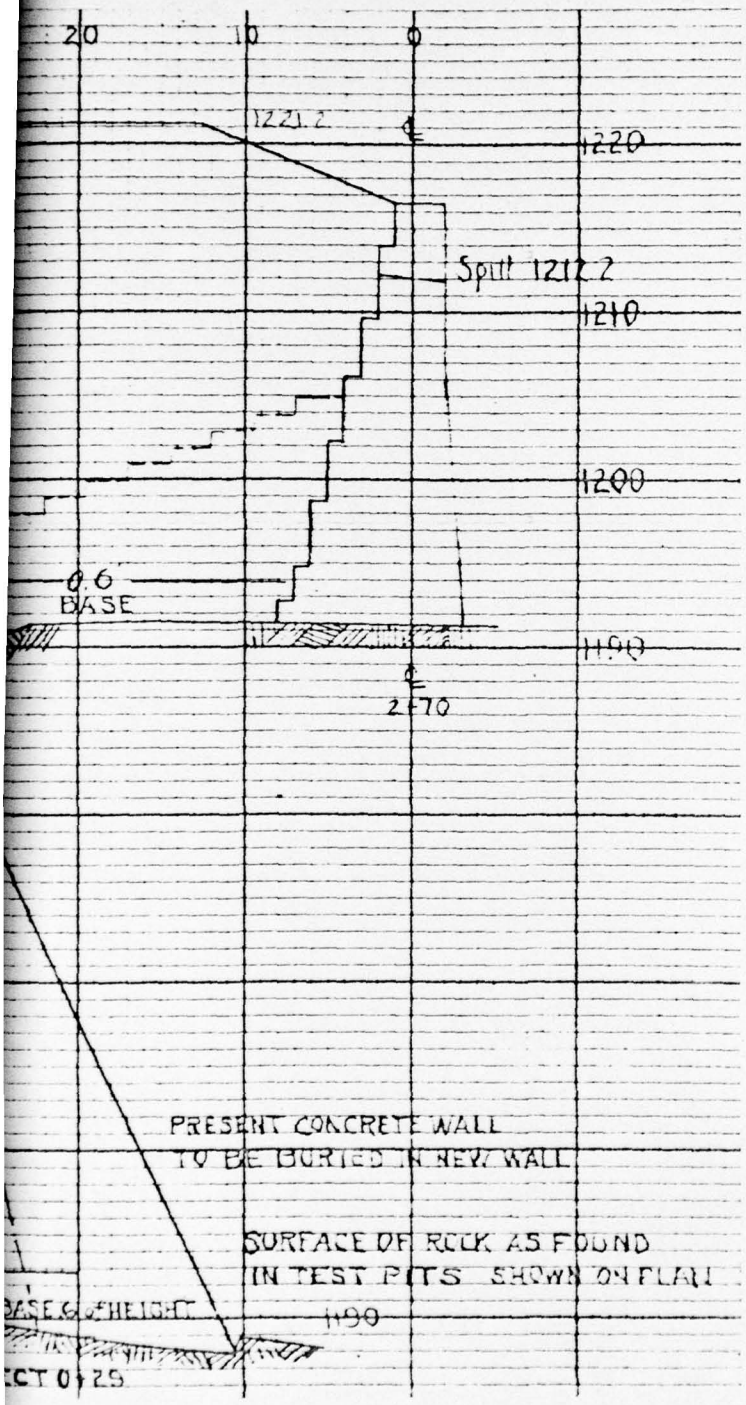
PENNSYLVANIA GAS AND WATER COMPANY

EMBANKMENT SECTIONS

FEBUARY 1979 PLATE 3


150
140
130
120
110
100
1200
1190
1180
EL 1196
BRIDGE
3
16" CAST IRON
0.6'
BASE
1197
6.7
PROFIL
1190
SECT 1+23
BASE 6 of HEIGHT
SECT 1+05
BASE 6 of HEIGHT


90
80
70
60
50
40
30
20
10
0
1221.2
TOP OF PROPOSED WALL
PRESENT WALL
TOP OF
0.7
BASE
7 to 6
0.6
BASE
2+70
ALONG FACE OF WALL
BATTER
½" per foot
PRESENT CONCRETE WA
TO BE BURIED IN NE
SURFACE OF RO
IN TEST PITS
1190
BASE 6/7 HEIGHT
SECT 0+29
SECT 0+39.5
BASE 7/7 HEIGHT
SECT 69.5
BASE 7/7 HEIGHT
SECT 1+07
BASE 7/7 HEIGHT



SCRANTON SPRING BROOK WATER SERVICE CO.
SCRANTON, PENNA.

DUNMORE Nº 1 DAM
PROFILE AND SECTION
OF
PROPOSED WINGWALL

DRAWN BY WRB	H A VICKER
CHECKED BY	CHIEF ENGINEER
DATE APRIL 15 1947	
SCALE 1" = 10'	00-35.434

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
HAROLD A. VICKER
ENGINEER NO. 6099

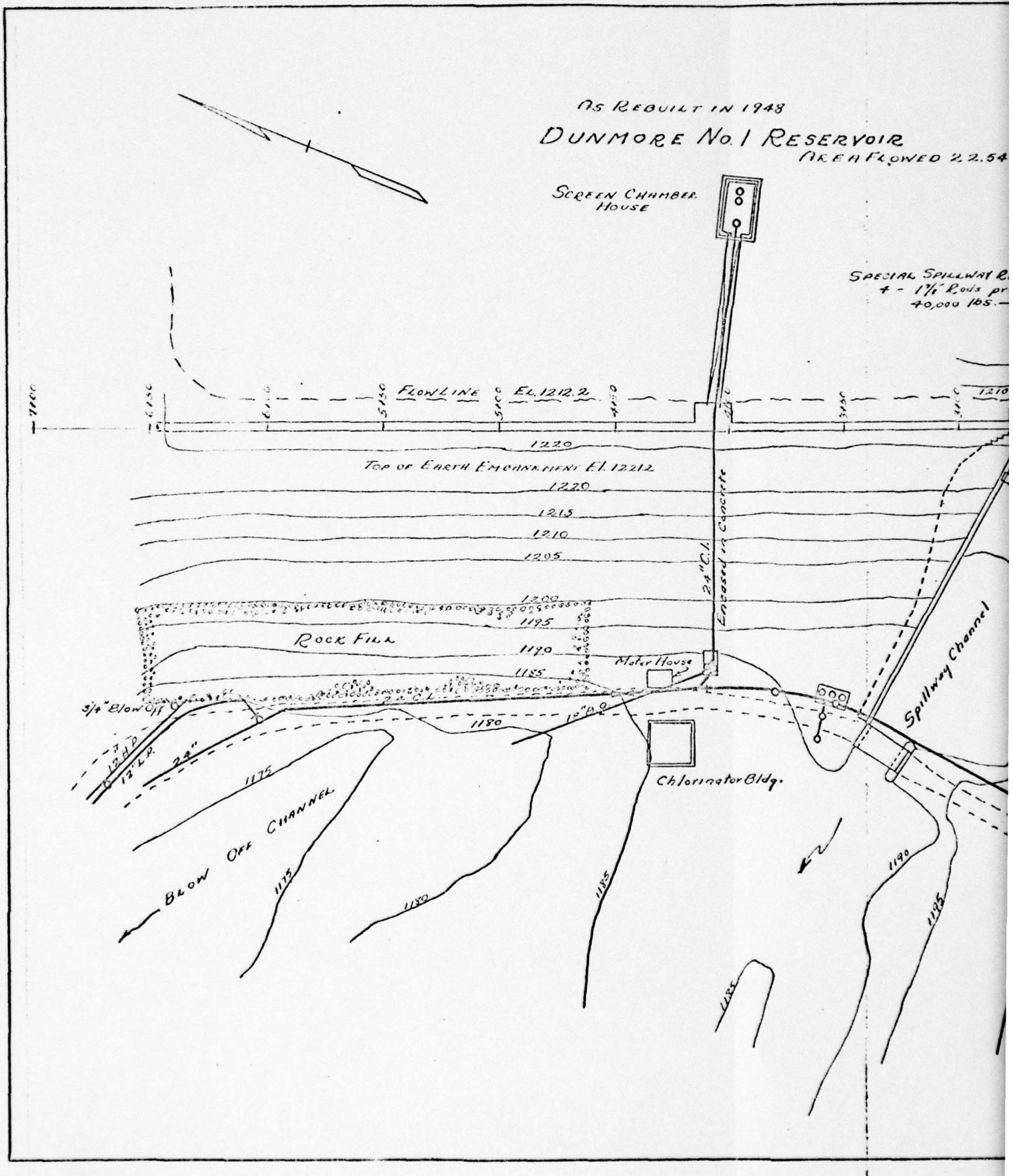
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

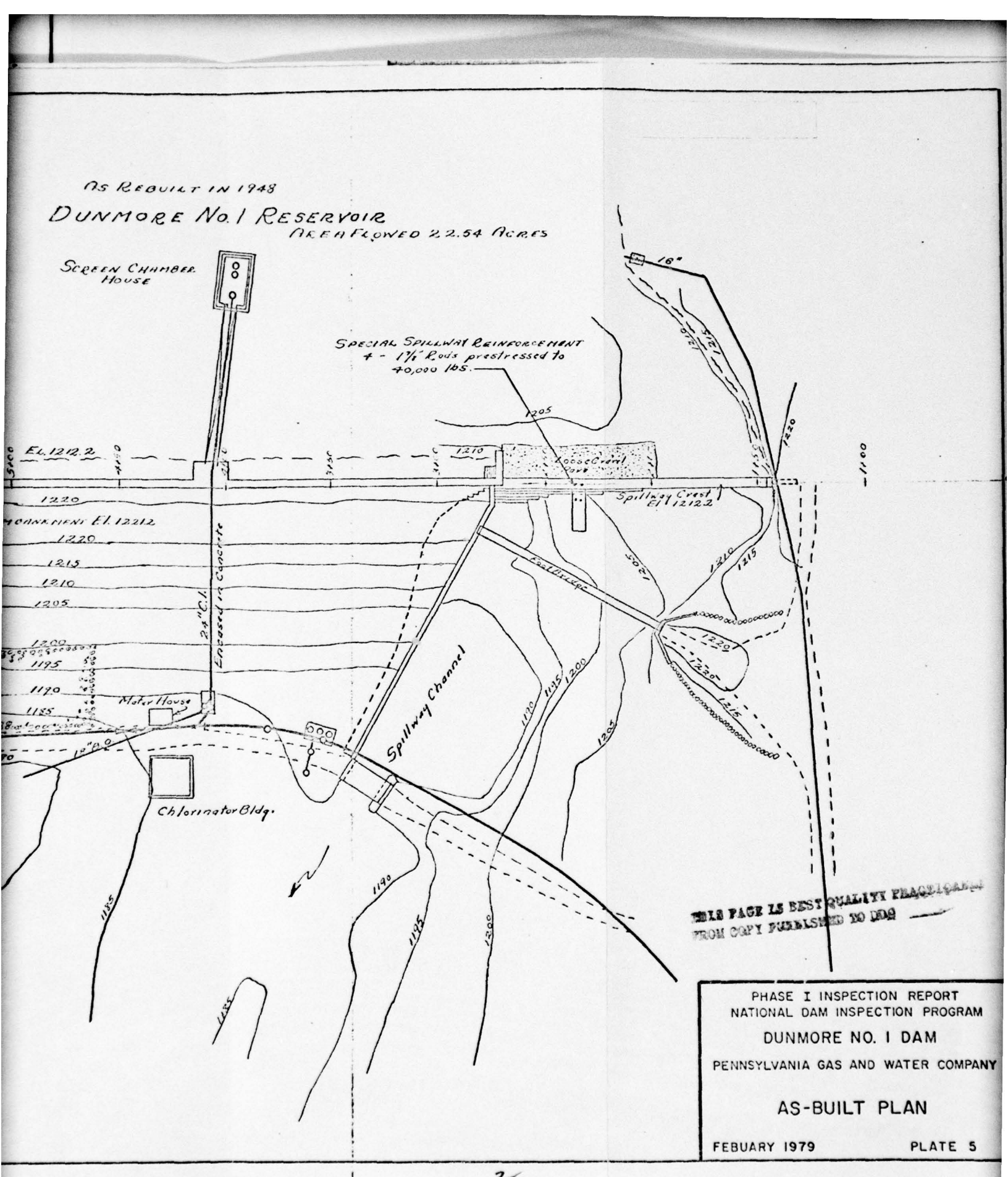
DUNMORE NO. 1 DAM

PENNSYLVANIA GAS AND WATER COMPANY

SPILLWAY SECTIONS

FEBUARY 1979 PLATE 4


AS REBUILT IN 1948
DUNMORE No. 1 RESERVOIR
AREA FLOWED 22.54
SCREEN CHAMBER HOUSE
SPECIAL SPILLWAY R
4 - 1⅛" Rods pr
40,000 lbs.
FLOWLINE EL. 1212.2
1220
TOP OF EARTH EMBANKMENT EL. 12212
1220
1215
1210
1205
1200
1195
1190
1185
1180
1175
24" C.I. Encased in Concrete
ROCK FILL
Meter House
3/4" Blow Off
12" D.O.
12" H.P.
12" L.P.
24"
Chlorinator Bldg.
Spillway Channel
BLOW OFF CHANNEL



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 1 DAM

PENNSYLVANIA GAS AND WATER COMPANY

AS-BUILT PLAN

FEBUARY 1979 PLATE 5

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: DUNMORE NO. 1

NDI ID NO.: PA-00364 DER ID NO.: 35-25

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	FOR MODIFICATION "AS BUILT DRAWINGS" SEE PLATES
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT - 1877 RECONSTRUCTED - 1891 RAISED - 1901 SPILLWAY CAPACITY INCREASED - 1903 CONCRETE INTAKE CONSTRUCTED - 1908 SPILLWAY CAPACITY INCREASED - 1914 RAISED - 1947
TYPICAL SECTIONS OF DAM	SEE PLATES.
OUTLETS: Plan Details Constraints Discharge Ratings	SEE PLATE 2

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	GENERAL DESIGN REPORT by THOMAS WIGGINS FOR 1947 MODIFICATION
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1914 REPORT by PENNSYLVANIA WATER SUPPLY COMMISSION ALSO SEE "DESIGN REPORTS"
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	NONE AFTER 1947 MODIFICATION

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	NOT AVAILABLE
MONITORING SYSTEMS	NONE
MODIFICATIONS	SEE CONSTRUCTION HISTORY
HIGH POOL RECORDS	NONE
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE AFTER 1947 MODIFICATION.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE AFTER 1947 MODIFICATION

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	SEE PLATES
OPERATING EQUIPMENT: Plans Details	NONE
PREVIOUS INSPECTIONS Dates Deficiencies	BEFORE 1947 MODIFICATION: 1921 - TOP OF CONCRETE WALL DISINTEGRATING SLIGHTLY. ABOUT 17 gpm SEEPING NEAR OUTLET WORKS OUTFALL 1924 - AS ABOVE AND SLIGHT SETTLEMENT OF EARTHFILL UPSTREAM OF MAIN WALL. 1928 - SMALL FLOW BY OUTLET PIPES. SWAMPY AT FOOT OF RIGHT HILL TOP OF CONCRETE WALL - SLIGHT DISINTEGRATION SLIGHT SEEPAGE THROUGH MAIN WALL ALONG ENTIRE LENGTH.
(CONTINUED)	1931 - SMALL STREAM JUST ABOVE OUTLET PIPE. 1933 - IDENTICAL TO 1928 INSPECTION

4-4

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED).	1941 - JOINTS NEED REPOINTING. SEEPAGE THROUGH JOINTS AND BOTH UNDER OUTLET PIPE AND 25' TO THE RIGHT. CONCRETE IS SOMEWHAT DISINTEGRATED ON RIGHT SPILLWAY WALL.
CONTINUED.	SEEPAGE AT RIGHT END OF DAM. 1943 - AS 1941, EXCEPT NO SEEPAGE AT RIGHT END OF DAM. JOINTS IN PROCESS OF BEING REPOINTED. 1945 - AS 1941, EXCEPT JOINTS HAD BEEN
	REPOINTED. AFTER 1947 MODIFICATION: 1953 - NO DEFICIENCIES 1957 - SMALL AMOUNT OF SEEPAGE IN SPILLWAY WALL.
	1965 - SLIGHT SEEPAGE AT DOWNSTREAM TOE.

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: DUNMORE NO. 1 County: LACKAWANNA State: PENNSYLVANIA

NDI ID No.: PA-00364 DER ID No.: 35-25

Type of Dam: EARTHFILL WITH MASONRY WALL Hazard Category: HIGH

Date(s) Inspection: 24 OCTOBER 1978 Weather: CLEAR Temperature: 60°F

SOIL CONDITIONS: VERY MOIST

B-1

Pool Elevation at Time of Inspection: 1208.3 msl/Tailwater at Time of Inspection: 1175± msl

Inspection Personnel:

D. WOLF (GFCC)

D. EBERSOLE (GFCC)

A. WHITMAN (GFCC). Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	2 UTILITY POLES IN EMBANKMENT.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	AT TOE, 70' LT OF RIGHT ABUTMENT, A HOLE 2' DEEP x 6' x 10'	OWNER REPORTS A VALVE WAS DUG UP THERE AND THE HOLE NEVER BACKFILLED.
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	MINOR RUTS ON TOP NEAR SPILLWAY AND ALSO NEAR BRIDGE TO SCREEN CHAMBER - TWO 2'x3'± VERY SHALLOW SLOUGHS.	DAMAGE BY MOWING EQUIPMENT
CREST ALIGNMENT: Vertical Horizontal	SEE SURVEY INFORMATION FOLLOWING INSPECTION FORMS.	
RIPRAP FAILURES	POORLY GRADED WITH CLUSTERS OF LARGE AND SMALL STONES. Riprap does NOT EXTEND TO RIGHT ABUTMENT AND IS WASHED OUT NEAR BRIDGE	TO SCREEN CHAMBER. RIPRAP DOES NOT EXTEND TO TOP OF DAM

B-2

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	NONE	
ANY NOTICEABLE SEEPAGE	IN OLD OUTLET WORKS CHANNEL TOTAL SEEPAGE OF 5 gpm ± - SOURCE NOT VISIBLE	SEEPAGE IS CLEAR.
STAFF GAGE AND RECORDER	NONE	
BRUSH	SLIGHT BRUSH ON RIPRAP ON DOWNSTREAM SLOPE	SOD IS EXCELLENT EXCEPT AT 2 SLOUGHED AREAS NOTED AND AT RIGHT ABUTMENT
DRAINS	NONE	
"CORE WALL"	2'8" ± CAP ON MASONRY CORE WALL - CONCRETE IS PEELING ON SIDES.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	CIP	
INTAKE STRUCTURE	SUBMERGED	ARRANGEMENT OF VALVE STEMS IN INTAKE: FLOW ↓ O O } LARGE, O O } SMALL
OUTLET STRUCTURE	ABANDONED 18" CIP 1/2 FULL OF SOIL	OWNER DOES NOT CONSIDER EMERGENCY DRAWDOWN LINES OPERATIONAL.
OUTLET CHANNEL	OVERGROWN AND FILLED IN AT END - STANDING WATER.	NOT USED
EMERGENCY GATE	NO ACTIVE DRAWDOWN FACILITIES.	

B-4

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
~~CONCRETE~~ WEIR MASONRY	MORTAR SLIGHTLY DETERIORATED.	
APPROACH CHANNEL	ALMOST FLAT - EARTHEN 2'8" BELOW SPILLWAY CREST.	
DISCHARGE CHANNEL	MOSTLY BEDROCK DRY MASONRY WALL DOWNSTREAM TO LEFT OF SPILLWAY	MANY SMALL SEEPS THROUGH BEDROCK.
BRIDGE AND PIERS	TO TOP OF DAM - NO DEFICIENCIES.	
Spillway Right Wall	SEE PHOTOGRAPHS SPALLED AT TOP PATTERN CRACKS AND LEACHING - ONE 3" POPOUT.	

B-5

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	1V ON 4H - 1V ON 5H±	
SEDIMENTATION	NO REPORTED OR APPARENT PROBLEMS	
WATERSHED DESCRIPTION	WOODED AND UNINHABITED	DAMS UPSTREAM

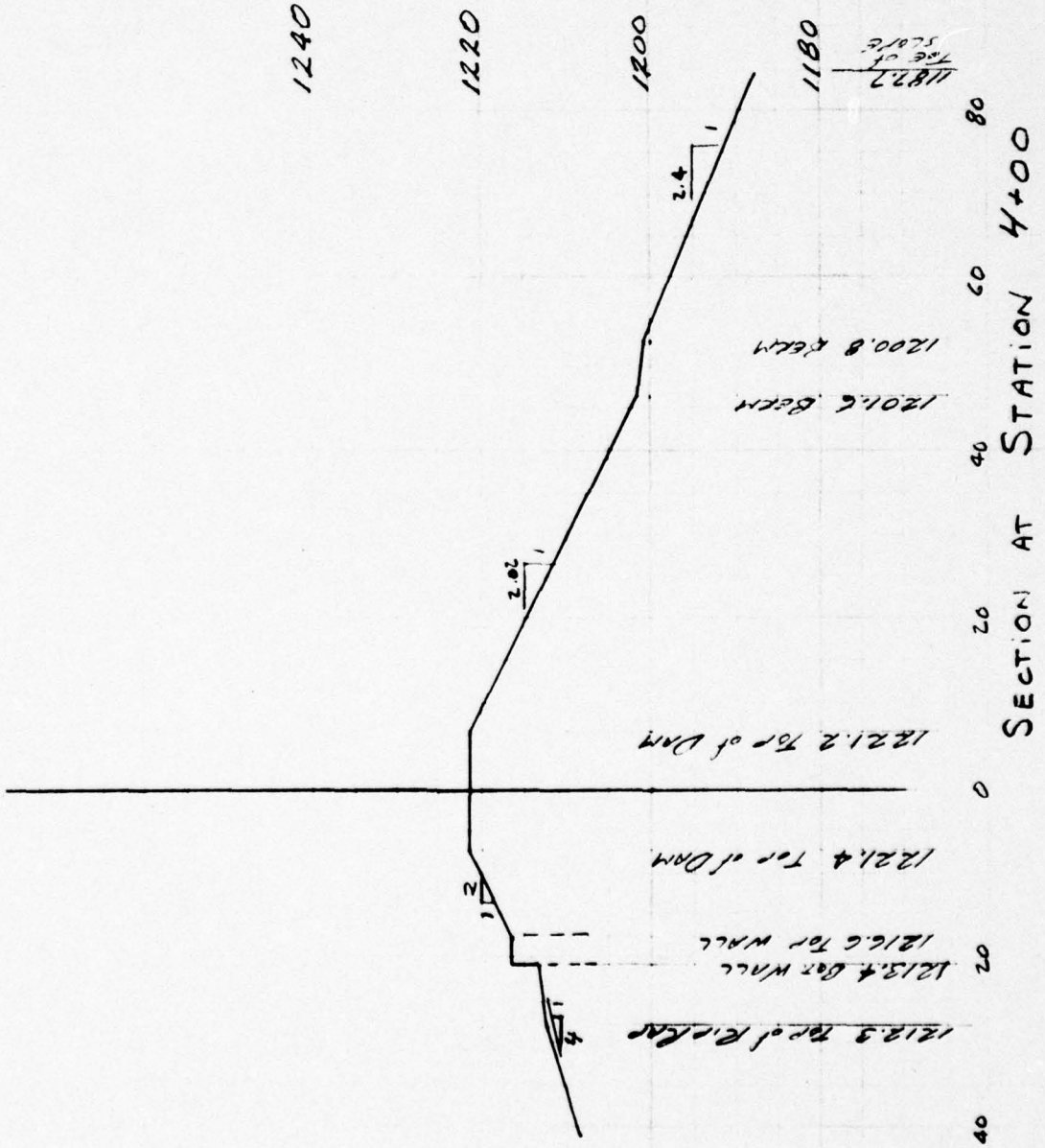
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	2 CULVERTS SEE APPENDIX C.	
SLOPES	FAIRLY STEEP.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	MANY LOW LYING DOWNSTREAM OF CULVERTS	FLOODING PATTERN IS COMPLEX.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT DUNMORE No. 1 RESERVOIR FILE NO. 785-2
SECTION - EMBANKMENT SHEET NO. ____ OF ____ SHEETS
FOR
COMPUTED BY DKE DATE 12-7-78 CHECKED BY ____ DATE ____

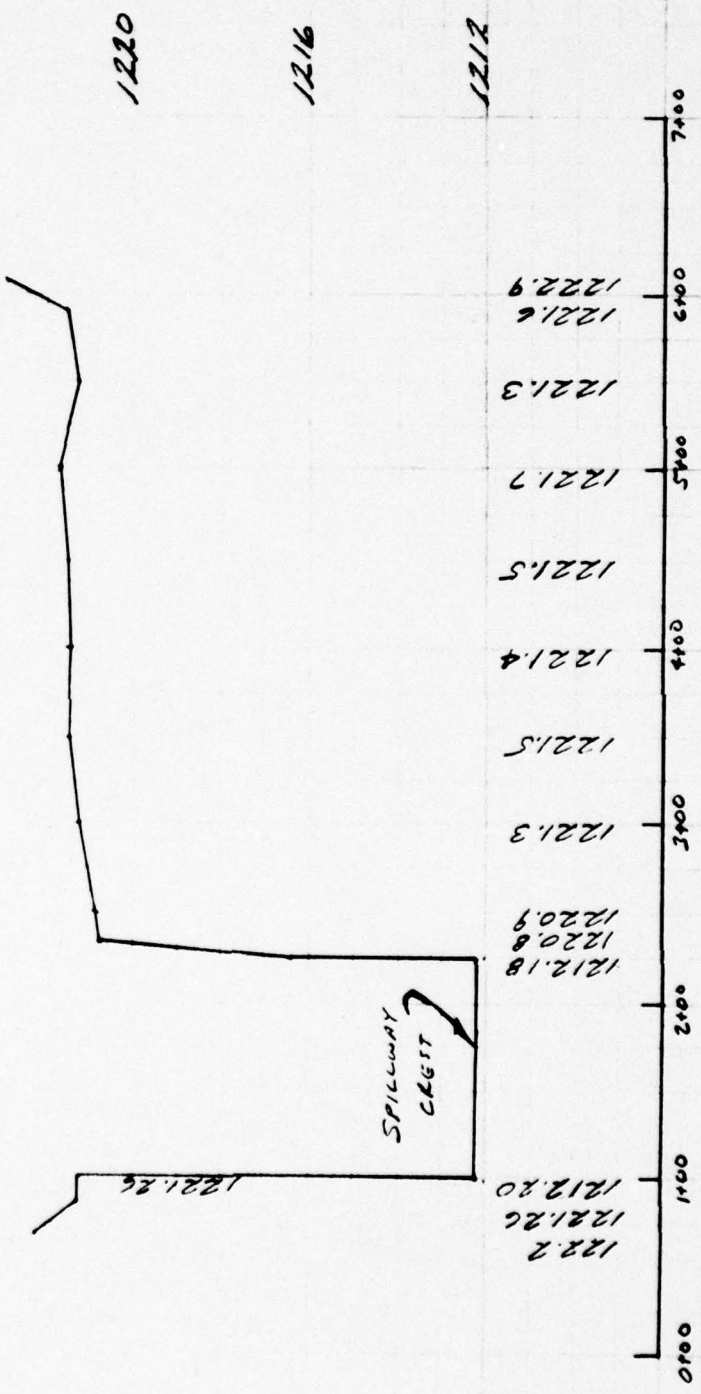


B-9

8513

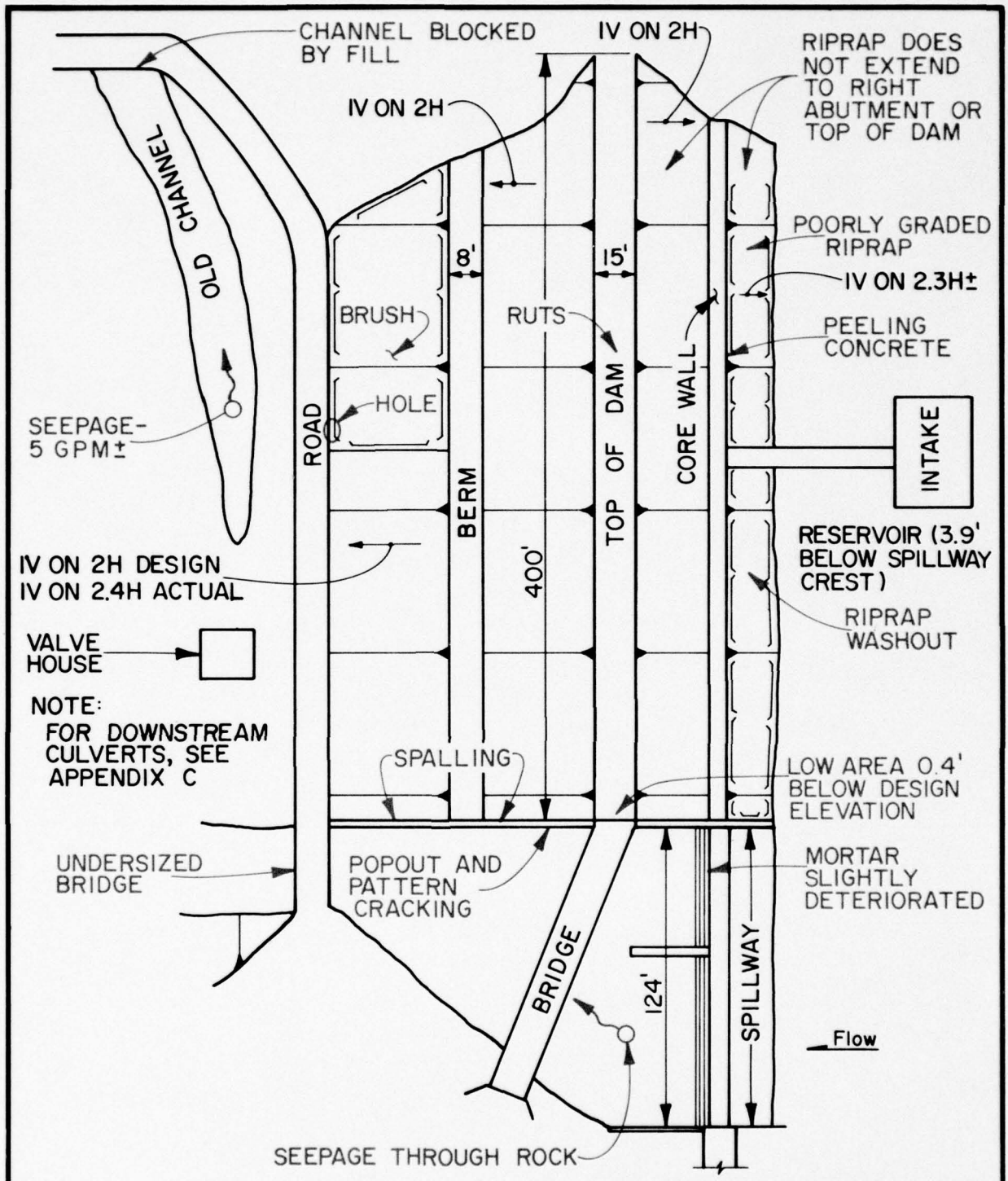
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Dunmore No. 1 Reservoir FILE NO. 7832
Profile - Top of Dam SHEET NO. ____ OF ____ SHEETS
FOR
COMPUTED BY DRE DATE 12-7-78 CHECKED BY ____ DATE ____



B-10

8913


CHANNEL BLOCKED BY FILL
IV ON 2H
IV ON 2H
RIPRAP DOES NOT EXTEND TO RIGHT ABUTMENT OR TOP OF DAM
OLD CHANNEL
8'
15'
POORLY GRADED RIPRAP
IV ON 2.3H±
BRUSH
RUTS
PEELING CONCRETE
HOLE
ROAD
BERM
TOP OF DAM
CORE WALL
INTAKE
SEEPAGE- 5 GPM±
400'
RESERVOIR (3.9' BELOW SPILLWAY CREST)
IV ON 2H DESIGN
IV ON 2.4H ACTUAL
RIPRAP WASHOUT
VALVE HOUSE
NOTE:
FOR DOWNSTREAM CULVERTS, SEE APPENDIX C
SPALLING
LOW AREA 0.4' BELOW DESIGN ELEVATION
UNDERSIZED BRIDGE
POPOUT AND PATTERN CRACKING
MORTAR SLIGHTLY DETERIORATED
BRIDGE
124'
SPILLWAY
Flow
SEEPAGE THROUGH ROCK
NOT TO SCALE
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
DUNMORE NO. 1 DAM
PENNSYLVANIA GAS AND WATER COMPANY
RESULTS OF VISUAL INSPECTION
FEBUARY 1979
PLATE B-1

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE No. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 24' 55" Longitude: W 75° 35' 55"

Top of Dam (low spot) Elevation: 1220.8

Streambed Elevation: 1174.0 Height of Dam: 47 ft

Reservoir Storage at Top of Dam Elevation: _____ acre-ft

Size Category: INTERMEDIATE

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: PMF

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
DUNMORE No. 4	3.7	14	55	
DUNMORE No. 3	3.5	13	78	
MARSHWOOD	2.2	14	286	

DOWNSTREAM DAMS

NONE				

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 24' 55" Longitude: W 75° 35' 55"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas A1 of 0.23 sq. mile

A2 0.14

A3 1.27

A4 2.85

– –

Total Drainage Area 4.49 sq. mile

PMF Rainfall Index = 22.15 in., 24 hr., 200 sq. mile

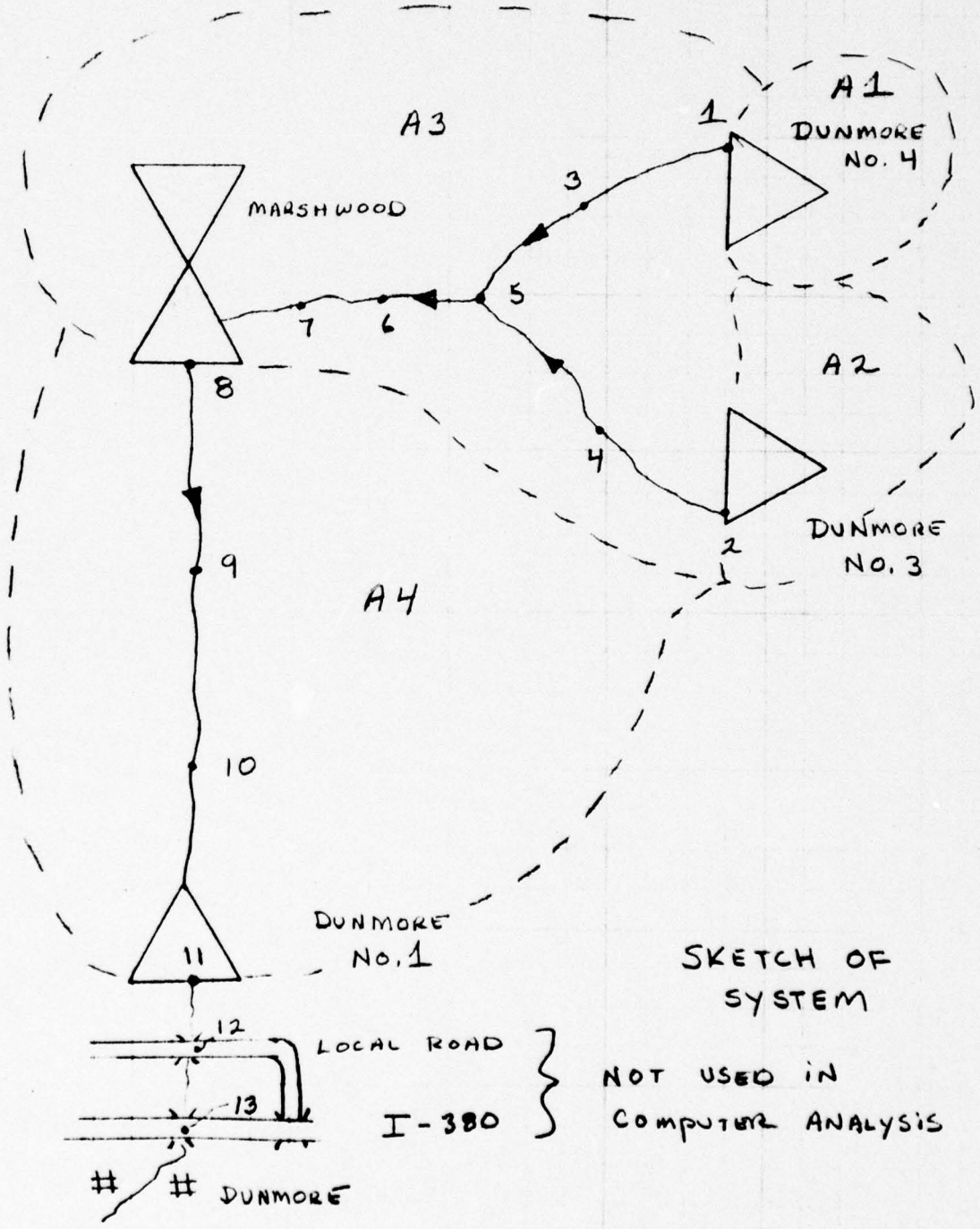
	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	
Geographic Adjustment Factor	97%	1.0
Revised Index Rainfall	21.5 in.	

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	118
12 hours	127
24 hours	136
48 hours	142
72 hours	145
96 hours	N/A

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SKETCH OF SYSTEM

NOT USED IN COMPUTER ANALYSIS

C-4

8313

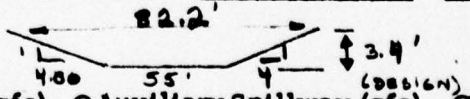
Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-4)

Name of Dam: DUNMORE No. 4 Sheet 1 of ___

Height: 14 FEET (APPROX) (existing) (FROM DER RECORDS)

Spillway Data: FROM DATA IN MARSHWOOD DAM PHASE I REPORT	Existing Conditions	Design Conditions
Top of Dam Elevation	2016.5	2017.1
Spillway Crest Elevation	2013.7	2013.7
Spillway Head Available (ft)	2.8	3.4
Type Spillway	TRAPEZOIDAL	
"C" Value - Spillway	2.7	2.7
Crest Length - Spillway (ft)	55	55
Spillway Peak Discharge (cfs)	~~888~~	1239 *
Auxiliary Spillway Crest Elevation	NONE	NONE
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)	888	1239

Spillway ~~Rating Curve~~: SECTION



Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
2013.7	0	N/A	0
2014.4	98		98
2015.1	282		282
2015.7	528		528
2016.4	830		830
2017.0	1182		1182
2017.7	1584		1584

* 1040 CFS IN REPORT 3/22/46
THOS. H. WIGGIN
CONSULTING ENGINEER

Data for Dam at Outlet of Subarea A1

Name of Dam: DUNMORE NO.4 Sheet 3 of __

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1998.4 = ELEVO*	0	0	0	
2013.7 = ELEV1	6 = A1	10	30.7 = S1	FROM DER RECORDS
2020	20.6			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ NORMAL POOL is 4 percent of watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 25' 55" Longitude: W 75° 33' 45"

Drainage Area: 4.49 sq. mile

Data for Subarea: A1 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: DUNMORE NO. 4

Drainage Area of Subarea: 0.23 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = .625 mile

L_{CA} = Length of Main Watercourse to the centroid = .283 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 0.89 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 0.3 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A-2
(see Sketch on Sheet C-2)

Name of Dam: DUNMORE NO.3 Sheet 1 of

Height: 13 FT ± ~~(existing)~~ OUTLET WORKS IGNORED FOR FLOODFLOWS

Spillway Data: FROM PHASE I REPORT ON DUNMORE NO.3 DAM	Existing Conditions	Design Conditions
Top of Dam Elevation	2022.8	2023.3
Spillway Crest Elevation	2021.0	2021.0
Spillway Head Available (ft)	1.8	2.3
Type Spillway	OGEE TYPE TOP	
"C" Value - Spillway	3.17*	3.17*
Crest Length - Spillway (ft)	48.0	48.0
Spillway Peak Discharge (cfs)	395	581
Auxiliary Spillway Crest Elevation	NONE	NONE
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)	395	581

Spillway Rating Curve:

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
2021	0		0
2021.8	100		100
2022.5	288		288
2023.2	538		538
2023.9	842		842
2024.4	1050		1050

* 530 CFS IN A REPORT 3/22/46
THOS. H. WIGGIN
CONSULTING ENGINEER.

Data for Dam at Outlet of Subarea A2

Name of Dam: DUNMORE NO.3 Sheet 3 of ___

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
2002.6 = ELEVO*	0	0	0	
2021 = ELEV1	9 = A1	18	55.2 = S1	
2040**	26.8			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 10 percent of watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 24' 55" Longitude: W 75° 35' 55"

Drainage Area: 4.49 sq. mile

Data for Subarea: A-2 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: DUNMORE NO. 3

Drainage Area of Subarea: 0.14 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 0.568 mile

L_{CA} = Length of Main Watercourse to the centroid = 0.292 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 0.58 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 0.2 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A3
(see Sketch on Sheet C-__)

Name of Dam: MARSHWOOD Sheet 1 of __

Height: 14 FEET (existing) OUTLET WORKS IGNORED FOR FLOODFLOWS

Spillway Data: FROM PHASE I REPORT ON MARSHWOOD DAM

	Existing Conditions	Design Conditions
Top of Dam Elevation	1540.8	1541.4
Spillway Crest Elevation	1537.0	1537.0
Spillway Head Available (ft)	3.8	4.4
Type Spillway	SHARP CRESTED CONCRETE WEIR	
"C" Value - Spillway	3.10	3.10
Crest Length - Spillway (ft)	100	100
Spillway Peak Discharge (cfs)	2296	2861
Auxiliary Spillway Crest Elevation	1537.2	1537.2
Auxiliary Spillway Head Available (ft)	3.6	4.2
Type Auxiliary Spillway	CANAL	
"C" Value - Auxiliary Spillway	N/A	N/A
Crest Length - Auxiliary Spillway (ft)	25	25
Auxiliary Spillway Peak Discharge (cfs)	≈400	≈530
Combined Spillway Discharge (cfs)	≈2700	≈3390

Spillway Rating Curve: FROM PHASE I REPORT ON MARSHWOOD DAM

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
1537.0	0	0	0
1537.2	28	0	28
1537.7	182	15	197
1538.2	408	47	455
1539.2	1012	152	1164
1540.3	1858	304	2162
1540.8	2296	397	≈2700
1541.4	2861	531	≈3390
1542.3	3782	741	4523
1545.3	7413	1733	9146

Data for Dam at Outlet of Subarea A3

Name of Dam: MARSHWOOD Sheet 3 of __

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1527.8 = ELEVO*	0	0	0	
1537 = ELEV1	37 = A1	38	116.6 = S1	
1540	39.9			
1560 **	63.6			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ NORMAL POOL is 5 percent of UNCONTROLLED watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 24' 55" Longitude: W 75° 35' 55"

Drainage Area: 4.49 sq. mile

Data for Subarea: A3 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: MARSHWOOD

Drainage Area of Subarea: 1.27 (UNCONTROLLED) sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 2.538 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.089 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.50

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 2.03 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 1.9 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A4
(see Sketch on Sheet C-4)

Name of Dam: DUNMORE No. 1 Sheet 1 of ___

Height: 47 FEET (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	1220.8	1221.2
Spillway Crest Elevation	1212.2	1212.2
Spillway Head Available (ft)	8.6	9.0
Type Spillway	BROAD CRESTED WEIR WITH INCLINED TOP	
"C" Value - Spillway	3.0 *	3.0 *
Crest Length - Spillway (ft)	124	124
Spillway Peak Discharge (cfs)	8830	9595
Auxiliary Spillway Crest Elevation	NONE	NONE
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)	8830	9595

Spillway Rating Curve:

* PENNDER REPORT ON APPLICATION BY THE OWNER.

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
	REDUCED BY TAILWATER		
	SEE SHEETS C-18 TO C-22		
	CURVE ON C-22		

Data for Dam at Outlet of Subarea A4

Name of Dam: DUNMORE NO. 1 Sheet 2 of ___

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction* = $29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5}$ = C			
Maximum Head (ft) = HM			
Q = C A $\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

NO OUTLETS CONSIDERED OPERATIONAL BY OWNER EXCEPT WATER SUPPLY LINE

* R = Hydraulic Radius = (Area/Wetted Perimeter) = D/4 for Circular Conduits.

Data for Dam at Outlet of Subarea A 4

Name of Dam: Dunmore No. 1 Sheet 3 of ___

Storage Data:

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
1182.2	= ELEVO*	0		0	0		
1212.2	= ELEV1	23	= A1	75	230.2	= S1	
1220		57.3					
1240 **		90.1					
	**						

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 1 percent of watershed.

Remarks: ___

SUSQUEHANNA River Basin

Name of Stream: LITTLE ROARING BROOK

Name of Dam: DUNMORE NO. 1

NDS ID No.: PA-00364

DER ID No.: 35-25

Latitude: N 41° 24' 55" Longitude: W 75° 35' 55"

Drainage Area: 4.49 sq. mile

Data for Subarea: A4 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: DUNMORE NO. 1

Drainage Area of Subarea: 2.85 (UNCONTROLLED) sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 3.295 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.098 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 2.21 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 4.3 cfs

Computer Data:

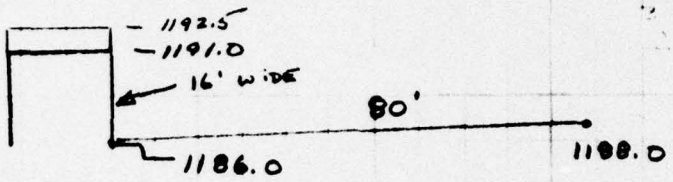
QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT DUNMORE NO. 1 FILE NO.
TAILWATER AT BRIDGE SHEET NO. OF SHEETS
FOR
COMPUTED BY DATE CHECKED BY DATE

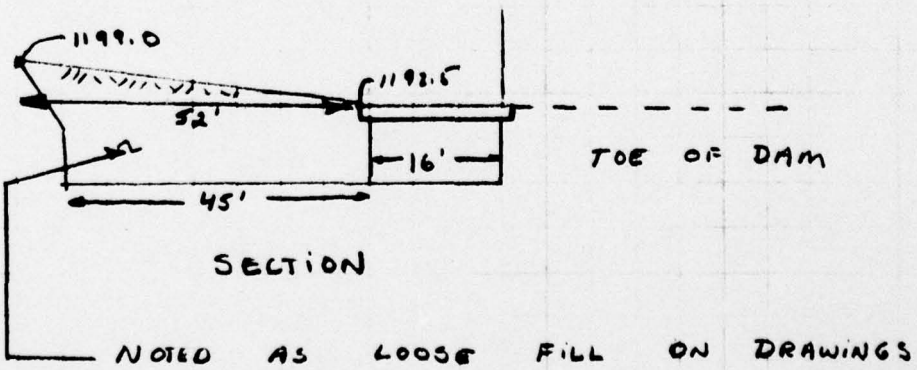


$S = \frac{2}{80} = 2.5\%$ $d_c = \sqrt[3]{\frac{Q^2}{b^2 g}}$

PROFILE $A = d \times 16'$

ASSUME CRITICAL depth UNDER BRIDGE $Q = \sqrt{d_c^3 A^2 g} = \sqrt{d^3 16^2 g}$

ELEV	d_c	EGL = 1.5 d_c	Q
1186	0	1186	0
1187	1	1188.5	91
1188	2	1191.0	257
1189	3	1193.5	472
1190	4	1196.0	724
1191	5	1198.5	1015



SECTION

NOTED AS LOOSE FILL ON DRAWINGS

SAY OVERTOPPING BY 0.5' MUST OCCUR BEFORE FILL WASHES OUT.
USE EL 1194.0

ONCE SECTION WASHES OUT, THE CHANNEL CAN HANDLE 5730 CFS WITH THE WATER SURFACE AT 1192.5
BACKWATER AFFECT WILL NOT REDUCE SPILLWAY CAPACITY.

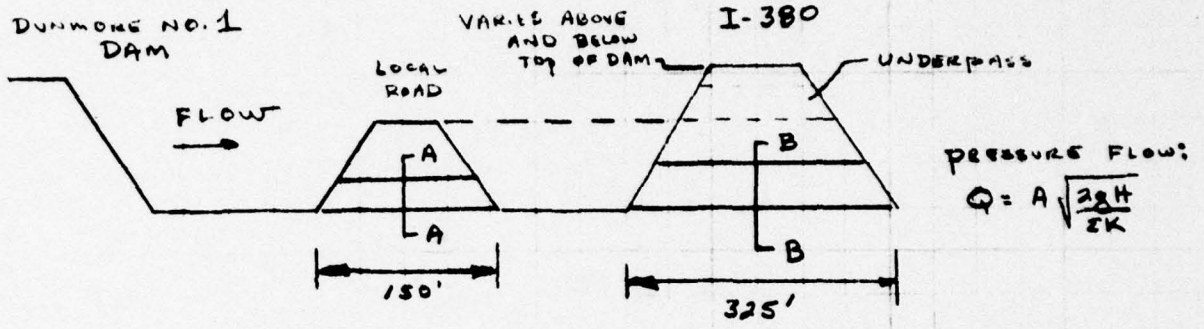
C-18

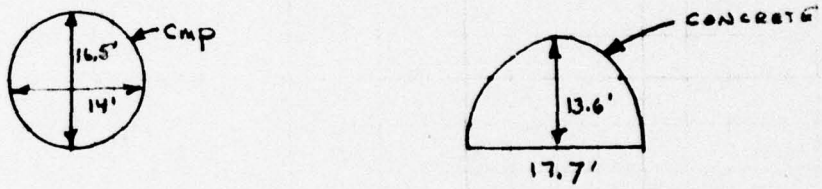
8819

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

CULVERTS DOWNSTREAM OF DUNMORE NO. 1





SECTION A SECTION B

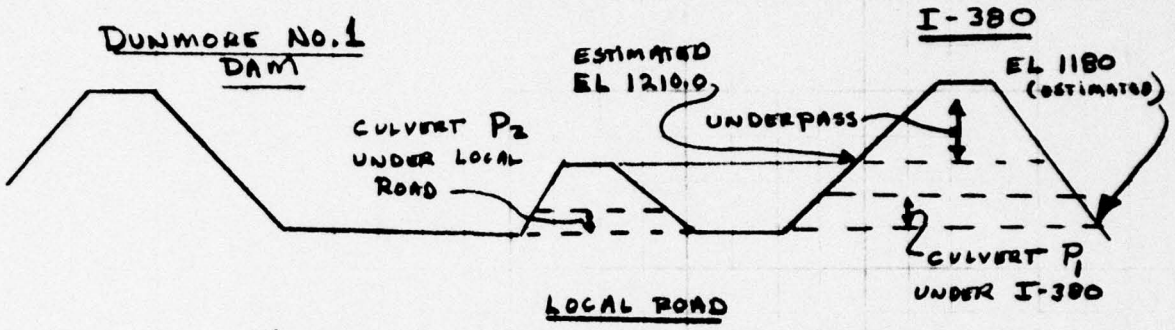
AREA	181.4	189.06
WETTED PERIMETER = P	47.91±	52.96
R = A/P	3.786	3,570
$R^{4/3}$	5.901	5.456
$\frac{29.1\,\eta^2 L}{R^{4/3}} = K_f$	.024 .426	.015 0.390
K_e (ENTRANCE LOSS)	0.5	0.5
K_o (EXIT LOSS)	1.0	1.0
ΣK	1.926	1.890
$Q = A\sqrt{\frac{2gH}{\Sigma K}} =$	$1048.6\sqrt{H}$	$1103.3\sqrt{H}$

8313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

CULVERTS DOWNSTREAM OF DUNMORE NO.1



LOCAL ROAD

ALTHOUGH A STRICTLY CORRECT ANALYSIS WOULD COMPUTE THE TAILWATER DOWNSTREAM OF I-380, TO THIS ADD THE HEADLOSS THROUGH P_1, AND THEN THE HEADLOSS THROUGH P_2; THIS WAS NOT DONE. IN ACTUALITY, THE LOCAL ROAD WILL OVERTOP WAY BELOW SPILLWAY CREST ELEVATION. ALTHOUGH THE LOCAL ROAD WILL PRODUCE BACKWATER, ONCE IT OVERTOPS THE WATER SURFACE UPSTREAM WILL NOT INCREASE SIGNIFICANTLY UNLESS THERE IS A BACKWATER EFFECT FROM P_1. THE WATER DEPTHS DOWNSTREAM FROM P_1 ARE ASSUMED NEGLIGIBLE BECAUSE THE OVERBANKS ARE LOW. AT EL 1210 (ESTIMATED) WATER WILL START TO FLOW THROUGH THE UNDERPASS. IT WAS ASSUMED THAT AT EL 1218 (3 FEET BELOW TOP OF DAM) I-380 WOULD OVERTOP TO THE RIGHT OF THE VALLEY. IT WAS ASSUMED THAT THIS WOULD MAINTAIN A CONSTANT WATER SURFACE ABOVE THIS ELEVATION. IN VIEW OF THE ESTIMATED ELEVATIONS, A MORE DETAILED ANALYSIS IS NOT WARRANTED.

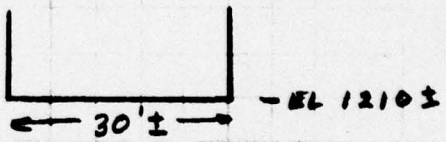
8513

REFERENCE PAGE C-20

THE LOSSES THROUGH P_1 ARE H_1.
(FROM PAGE C-19, $Q = 1103.3\sqrt{H_1}$)
WHERE $H_1 = \left(\frac{Q}{1103.3}\right)^2$

H_1 IS ADDED TO 1180.0 (INVERT) TO FIND HEADWATER AT P_1. IF THE HEADWATER IS ABOVE ELEVATION 1210 (THE UNDERPASS) AN ADDITIONAL DISCHARGE Q' IS ADDED:

THE APPROXIMATE UNDERPASS GEOMETRY:



ASSUMING CRITICAL DEPTH

$Q' = 3.1(\text{HEADWATER} - 1210)^{1.5} \times 30$
$= C \cdot H^{1.5} \cdot L$

A MORE REFINED C VALUE IS NOT WHARRANTED IN VIEW OF THE ESTIMATED ELEVATIONS.

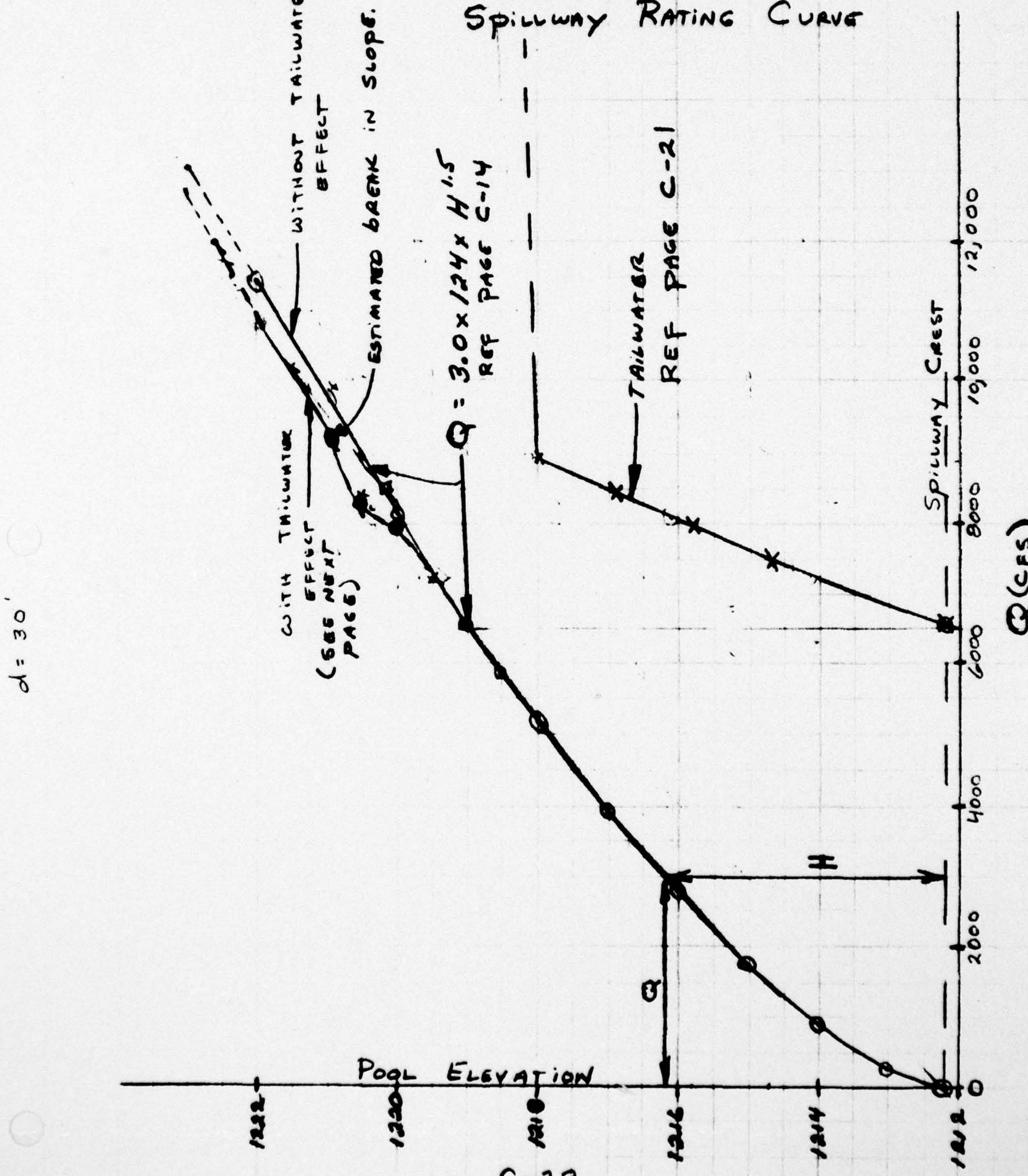
Q	H_1	HEADWATER	Q'	Q+Q'
1000	.82	1180.82	—	1000
2000	3.28	1183.29	—	2000
5000	20.64	1200.54	—	5000
6000	29.57	1209.57	—	6000
6500	34.71	1214.71	950	7450
6600	35.78	1215.78	1294	7894
6700	36.88	1216.88	1677	8377
6800	37.99	1217.99	2099	8899

REF. PAGE C-20, AT ELEVATION 1218, IT IS ASSUMED THAT I-380 OVERTOPS; AND ABOVE THAT EL., THE TAILWATER WILL NOT INCREASE

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ______ FILE NO. ______
______ SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______

DUNMORE NO. 1
SPILLWAY RATING CURVE



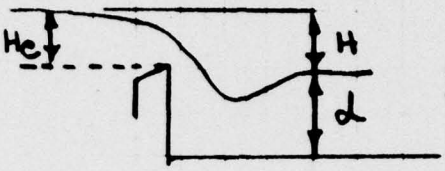
C-22

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

REDUCTION OF DISCHARGE BY TAILWATER

REFERENCE EM 1110-2-1603
PLATE 33



The PARAMETERS H/He AND $(H+d)/He$ ARE USED TO FIND THE % REDUCTION OF "C" USED IN $Q = CLH^{1.5}$

ASSUME bottom OF CHANNEL AT EL 1191.0

(1) Q, C=3.0	(2) Pool Elev	(3) He (2) - 1212.2	Tailwater Elev	H+d/He	H/He	% Reduction
5882	1218.5	6.3	1210.5	4.37	1.27	0.0
7337	1219.5	7.3	1214.4	3.90	0.70	0.8
8895	1220.5	8.3	1217.7	3.55	.34	5.3
10550	1221.5	9.3	1218.1	3.28	.37	3.2

FROM ABOVE

Q C=3.0	Pool Elev	Q C reduced by percentage above
5882	1218.5	5882
7337	1219.5	7278
8895	1220.5	8423
10550	1221.5	10212

The ABOVE WAS PLOTTED ON CURVE PAGE C-22, The discharge RATING WITH TAILWATER EFFECTS WAS SCALED OFF THE CURVE AND USED IN THE COMPUTER ANALYSIS

8913

APPENDIX C

SUMMARY

SEE SHEET C-4	A1 Subarea	A2 Subarea	A3 Subarea	A4 Subarea	Total
Drainage Area (sq. mile)	0.23	0.14	1.27 UNCONTR.	2.85 UNCONT.	4.49
PMF:					
Peak Outflow (cfs)	821	658	4378	11091	
Total Runoff (inches)					
Dam at Outlet?	YES	YES	YES	YES	
Is Dam Overtopped?	NO	YES	YES	YES	
Depth of Overtopping (ft)	—	0.21	0.74	0.74	
One-Half PMF:					
Peak Outflow (cfs)	414	273	2096	5280	
Total Runoff (inches)					
Dam at Outlet?	YES	YES	YES	YES	
Is Dam Overtopped?	NO	NO	NO	NO	
Depth of Overtopping (ft)	—	—	—	—	
Does Dam Fail?	NO	NO	NO	NO	
Peak Failure Outflow (cfs)	—	—	—	—	
At time (hrs)	—	—	—	—	
Spillway (percent of PMF)	100	72	65	84	

DOWNSTREAM SUMMARY

	Peak Water Surface Elevation Before Failure	After Failure	Remarks
Cross Section	NOT USED		
Cross Section			
Cross Section			
Cross Section			
Cross Section			

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

_____ SHEET NO. ____ OF ____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SELECTED COMPUTER OUTPUT

8513

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  17 OCT 78
**********
    1              A1                    DUNMORE DAMS AND MARSHWOOD DAM-GFCC
    2              A2                       LITTE ROARING BROOK AND ITS TRIBUTARY
    3              A3                          DUNMORE NO.1 DAM
    4              B     300         0        15         0         0         0         0         0        -4         0
    5              B1      5
    6              J       1         6         1
    7              J1      1        .8        .6        .5        .4        .3
    8              K       0         1                                      1
    9              K1        DUNMORE 4 RUNOFF
   10              M       1         1       .23                 4.49
   11              P                21.5       118       127       136       142       145
   12              T                                                          1       .05                 .04
   13              W     0.99      0.62
   14              X     -1.5      -.05       2.0
   15              K       1         1                                      1
   16              K1        DUNMORE 4 ROUTING
   17              Y                                     1
   18              Y1      1                                                -2013.7     -1
   19              Y42013.7  2014.4    2015.1    2015.7    2016.4    2017.0    2017.7    2018.2    2019.0
   20              Y5      0        98       282       528       829      1182      1584      1941      2588
   21              SA      0         6      20.6
   22              SE1998.4  2013.7    2020
   23              SS2013.7       55       2.7       1.5
   24              SD2016.5      2.7       1.5       400
   25              K       1         5                                      1
   26              K1        SECT 3 DNSTRM NO 4 DAM
   27              Y                                     1
   28              Y1      1                                                -1
   29              Y6    .08       .07       .08      1895      1920      4850     .0475
   30              Y7      0      1940       310      1920       630      1980       800      1895       810      1895
   31              Y7    940      1900      1200      1920      1480      1940
   32              K       0         2                                      1
   33              K1        DUNMORE 3 RUNOFF
   34              M       1         1       .14                 4.49
   35              P                21.5       118       127       136       142       145
   36              T                                                          1       .05                 .1
   37              W     .58       .62
   38              X     -1.5      -.05       2.0
   39              K       1         2                                      1
   40              K1        DUNMORE 3 ROUTING
   41              Y                                     1
   42              Y1      1                                                -2021       -1
   43              Y4    2021    2021.8    2022.5    2023.2    2023.9    2024.4    2025.4
   44              Y5      0       100       298       538       842      1050      1602
   45              SA      0         9      26.8
   46              SE2002.6      2021      2040
   47              SS    2021        48      3.17       1.5
   48              SD2022.8       2.7       1.5       700
   49              K       1         5                                      1
   50              K1        SECT 4 DNSTRM NO. 3 DAM
```

C-25

```
Y                                   1
Y1      1                                                    -1
Y6    .08       .07       .08    1900    1920    2750     .076
Y7      0      1960       220    1940     450    1920     1200    1900    1300    1900
Y7   2200      1920      2400    1940    2600    1920
K       2         5                                          1
K1          COMBINE FLOW NO.3 & NO.4
K       1         6                                          1
K1          SECT 6 DNSTRM
Y                                   1
Y1      1                                                    -1
Y6    .08       .07       .08    1740    1765    1600     .081
Y7      0      1800       300    1790     470    1760      600    1740     610    1740
Y7   1200      1740      1950    1760    2600    1800
K       1         8                                          1
K1          SECT 7 DNSTRM
Y                                   1
Y1      1                                                    -1
Y6    .08       .07       .08    1590    1620    3000      .05
Y7      0      1680       100    1620     300    1600      430    1590     440    1590
Y7    640      1600       810    1620    1400    1680
K       0         8                                          1
K1          MARSHWOOD UNCONTR. RUNOFF
M       1         1      1.27            4.49
P              21.5       118     127     136     142      145
T                                                            1     .05             .05
W    2.03      0.62
X    -1.5      -.05       2.0
K       2         8                                          1
K1          COMBINE MARSHWOOD INFLOW
K       1         8                                          1
K1          MARSHWOOD ROUTING
Y                                   1
Y1      1                                                -1537      -1
Y4   1537    1537.2    1537.7  1538.2  1539.2  1540.3   1540.8  1541.4  1542.3  1545.3
Y5      0        28       197     455    1164    2162     2700    3390    4523    9146
SA      0        37      39.9    63.6
SE1527.8       1537      1540    1560
SS   1537
SD1540.8        2.7       1.5     470
K       1         9                                          1
K1          SECT 9  DNSTRM MARSHWOOD
Y                                   1
Y1      1                                                    -1
Y6    .10       .09       .10    1480    1520    2500     .061
Y7      0      1550       200    1540     400    1520      550    1500     610    1480
Y7    800      1500      1090    1520    1550    1540
K       1        10                                          1
K1          SECT 10 DNSTRM MARSHWOOD
Y                                   1
```

```
Y1     1                                             -1
Y6   .10     .09     .10    1320    1350    4700    .021
Y7     0    1400     250    1360     510    1340     890    1320     950    1320
Y7  1000    1340    1120    1360    1400    1400
K      1      11                                       1
K1      SECTIOA DNSTRM MARSHWOOD
Y                              1
Y1     1                                             -1
Y6   .10     .09     .10    1266    1290    4850    .014
Y7     0    1400     690    1300    1180    1280    1340    1266    1350    1266
Y7  1480    1280    1620    1300    1850    1400
K      0      11                                       1
K1      DUN NO.1 UNCTR.RUNOFF
N      1       1    2.85            4.49
P           21.5     118     127     136     142     145
T                                                      1     .05             .01
W   2.21    0.62
X   -1.5    -.05     2.0
K      2      11                                       1
K1      DUN 1 COMBINE RUNOFF
K      1      11
K1      DUN 1 ROUTING
Y                              1
Y1     1                                        -1212.2      -1
Y41212.2    1213    1216    1215    1217    1219    1220  1220.5    1221    1223
Y5     0     280     900    1740    3910    6600    7900    8200    9250   12700
SA     0      23    57.3    90.1
SE1182.2  1212.2    1220    1240
SS1212.2     124     3.0     1.5
SQ1220.8     2.7     1.5     520
K     99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1 1.00	RATIO 2 .80	RATIO 3 .60	RATIO 4 .50	RATIO 5 .40	RATIO 6 .30
HYDROGRAPH AT	1	.23	1	885.	708.	531.	442.	354.	265.
	(	.60)	(	25.06)(	20.05)(	15.04)(	12.53)(	10.02)(	7.52)(
ROUTED TO	1	.23	1	821.	661.	497.	414.	327.	240.
	(	.60)	(	23.25)(	18.71)(	14.07)(	11.72)(	9.27)(	6.79)(
ROUTED TO	5	.23	1	805.	646.	485.	404.	319.	229.
	(	.60)	(	22.78)(	18.30)(	13.74)(	11.43)(	9.03)(	6.47)(
HYDROGRAPH AT	2	.14	1	666.	533.	400.	333.	267.	200.
	(	.36)	(	18.87)(	15.09)(	11.32)(	9.43)(	7.55)(	5.66)(
ROUTED TO	2	.14	1	658.	499.	336.	273.	217.	155.
	(	.36)	(	18.64)(	14.13)(	9.51)(	7.73)(	6.14)(	4.40)(
ROUTED TO	5	.14	1	623.	453.	327.	268.	213.	154.
	(	.36)	(	17.64)(	12.83)(	9.25)(	7.59)(	6.04)(	4.35)(
2 COMBINED	5	.37	1	1339.	1081.	799.	659.	522.	376.
	(	.96)	(	37.91)(	30.62)(	22.61)(	18.66)(	14.79)(	10.64)(
ROUTED TO	6	.37	1	1347.	1073.	797.	662.	525.	375.
	(	.96)	(	38.15)(	30.38)(	22.57)(	18.75)(	14.87)(	10.62)(
ROUTED TO	8	.37	1	1318.	1067.	795.	658.	515.	371.
	(	.96)	(	37.32)(	30.21)(	22.50)(	18.64)(	14.58)(	10.52)(
HYDROGRAPH AT	8	1.27	1	3261.	2608.	1956.	1630.	1304.	978.
	(	3.29)	(	92.33)(	73.86)(	55.40)(	46.16)(	36.93)(	27.70)(
2 COMBINED	8	1.64	1	4397.	3543.	2668.	2224.	1776.	1332.
	(	4.25)	(	124.51)(	100.33)(	75.55)(	62.97)(	50.29)(	37.70)(
ROUTED TO	8	1.64	1	4378.	3490.	2535.	2096.	1672.	1236.
	(	4.25)	(	123.97)(	98.83)(	71.78)(	59.35)(	47.35)(	35.00)(
ROUTED TO	9	1.64	1	4370.	3494.	2539.	2097.	1671.	1233.
	(	4.25)	(	123.76)(	98.94)(	71.91)(	59.37)(	47.32)(	34.91)(
ROUTED TO	10	1.64	1	4352.	3460.	2515.	2080.	1659.	1218.
	(	4.25)	(	123.23)(	97.97)(	71.21)(	58.90)(	46.97)(	34.49)(
ROUTED TO	11	1.64	1	4315.	3416.	2489.	2057.	1639.	1202.
	(	4.25)	(	122.19)(	96.72)(	70.48)(	58.26)(	46.42)(	34.03)(
HYDROGRAPH AT	11	2.85	1	6951.	5561.	4170.	3475.	2780.	2085.
	(	7.38)	(	196.82)(	157.46)(	118.09)(	98.41)(	78.73)(	59.05)(

2 COMBINED	11	4.49	1	11235.	8951.	6574.	5433.	4321.	3172.
	(	11.63)	(	318.15)(	253.47)(	186.14)(	153.83)(	122.35)(	89.83)(
ROUTED TO	11	4.49	1	11091.	8449.	6357.	5280.	4199.	3090.
	(	11.63)	(	314.06)(	239.25)(	180.01)(	149.51)(	118.91)(	87.51)(

AD-A079 051 GANNETT FLEMING CORDDRY AND CARPENTER INC HARRISBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. DUNMORE NUMBER 1 DAM (NDI ID N--ETC(U)
FEB 79 A C HOOKE DACW31-79-C-0015

UNCLASSIFIED NL

2 OF 2
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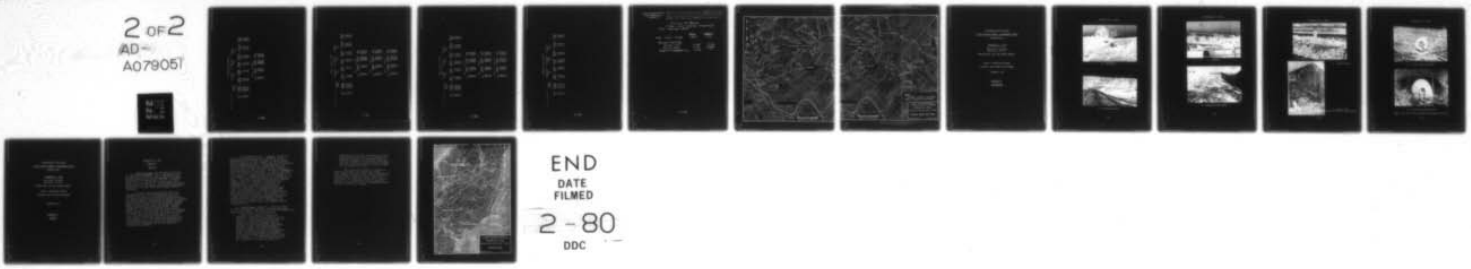
A079051



END
DATE
FILMED
2-80
DDC

SUMMARY OF DAM SAFETY ANALYSIS

DUNMORE NO.4 DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2013.70	2013.70	2016.50
STORAGE	31.	31.	5[illegible].
OUTFLOW	0.	0.	888.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	2016.38	0.00	53.	821.	0.00	40.75	0.00
.80	2016.01	0.00	49.	661.	0.00	40.75	0.00
.60	2015.62	0.00	45.	497.	0.00	40.75	0.00
.50	2015.42	0.00	44.	414.	0.00	40.75	0.00
.40	2015.21	0.00	42.	327.	0.00	40.75	0.00
.30	2014.94	0.00	39.	240.	0.00	40.75	0.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	805.	1897.0	41.00
.80	646.	1896.8	41.00
.60	485.	1896.6	41.00
.50	406.	1896.5	41.00
.40	319.	1896.4	41.00
.30	229.	1896.2	41.25

SUMMARY OF DAM SAFETY ANALYSIS

Dunnsville No. 3 Dam

PLAN 1 ..... ELEVATION STORAGE OUTFLOW

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	2021.00	2021.00	2022.80
STORAGE	55.	55.	73.
OUTFLOW	0.	0.	395.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	2023.01	.21	75.	658.	1.25	40.25	0.00
.80	2022.91	.11	74.	499.	.75	40.50	0.00
.60	2022.63	0.00	71.	336.	0.00	40.50	0.00
.50	2022.44	0.00	69.	273.	0.00	40.50	0.00
.40	2022.24	0.00	67.	217.	0.00	40.50	0.00
.30	2022.01	0.00	65.	155.	0.00	40.50	0.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	623.	1900.9	40.50
.80	453.	1900.6	40.75
.60	327.	1900.4	40.75
.50	268.	1900.4	40.75
.40	213.	1900.3	40.75
.30	154.	1900.2	40.75

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1347.	1740.3	40.75
.80	1073.	1740.2	40.75
.60	797.	1740.2	41.00
.50	662.	1740.1	41.00
.40	525.	1740.1	41.00
.30	375.	1740.1	41.00

PLAN 1 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1318.	1593.1	41.00
.80	1067.	1592.8	41.00
.60	795.	1592.4	41.00
.50	658.	1592.2	41.00
.40	515.	1592.0	41.00
.30	371.	1591.7	41.25

C-31

SUMMARY OF DAM SAFETY ANALYSIS

Marshwood Dam

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1537.00	1537.00	1540.80
STORAGE	113.	113.	261.
OUTFLOW	0.	0.	2700.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1541.54	.74	292.	4378.	3.25	41.50	0.00
.80	1541.20	.40	278.	3490.	2.25	41.75	0.00
.60	1540.65	0.00	255.	2535.	0.00	41.75	0.00
.50	1540.23	0.00	238.	2096.	0.00	42.00	0.00
.40	1539.76	0.00	219.	1672.	0.00	42.00	0.00
.30	1539.28	0.00	200.	1236.	0.00	42.00	0.00

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	4370.	1488.2	41.50
.80	3494.	1487.4	41.75
.60	2539.	1486.6	42.00
.50	2097.	1486.2	42.00
.40	1671.	1485.6	42.00
.30	1233.	1484.9	42.25

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	4352.	1325.9	41.75
.80	3460.	1325.2	42.00
.60	2515.	1324.5	42.25
.50	2080.	1324.0	42.25
.40	1659.	1323.6	42.25
.30	1218.	1323.1	42.50

PLAN 1 STATION 11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	4315.	1274.4	42.00
.80	3416.	1273.7	42.25
.60	2489.	1272.7	42.50
.50	2057.	1272.3	42.50
.40	1639.	1271.7	42.50
.30	1202.	1271.0	42.75

SUMMARY OF DAM SAFETY ANALYSIS

Dunmore N.D. 4 Plan

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1212.20	1212.20	1220.80
STORAGE	230.	230.	579.
OUTFLOW	0.	0.	8830.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1221.54	.74	623.	11091.	2.25	42.25	0.00
.80	1220.62	0.00	569.	8449.	0.00	42.50	0.00
.60	1218.82	0.00	469.	6357.	0.00	42.50	0.00
.50	1218.02	0.00	430.	5280.	0.00	42.50	0.00
.40	1217.22	0.00	394.	4199.	0.00	42.50	0.00
.30	1216.24	0.00	354.	3090.	0.00	42.50	0.00

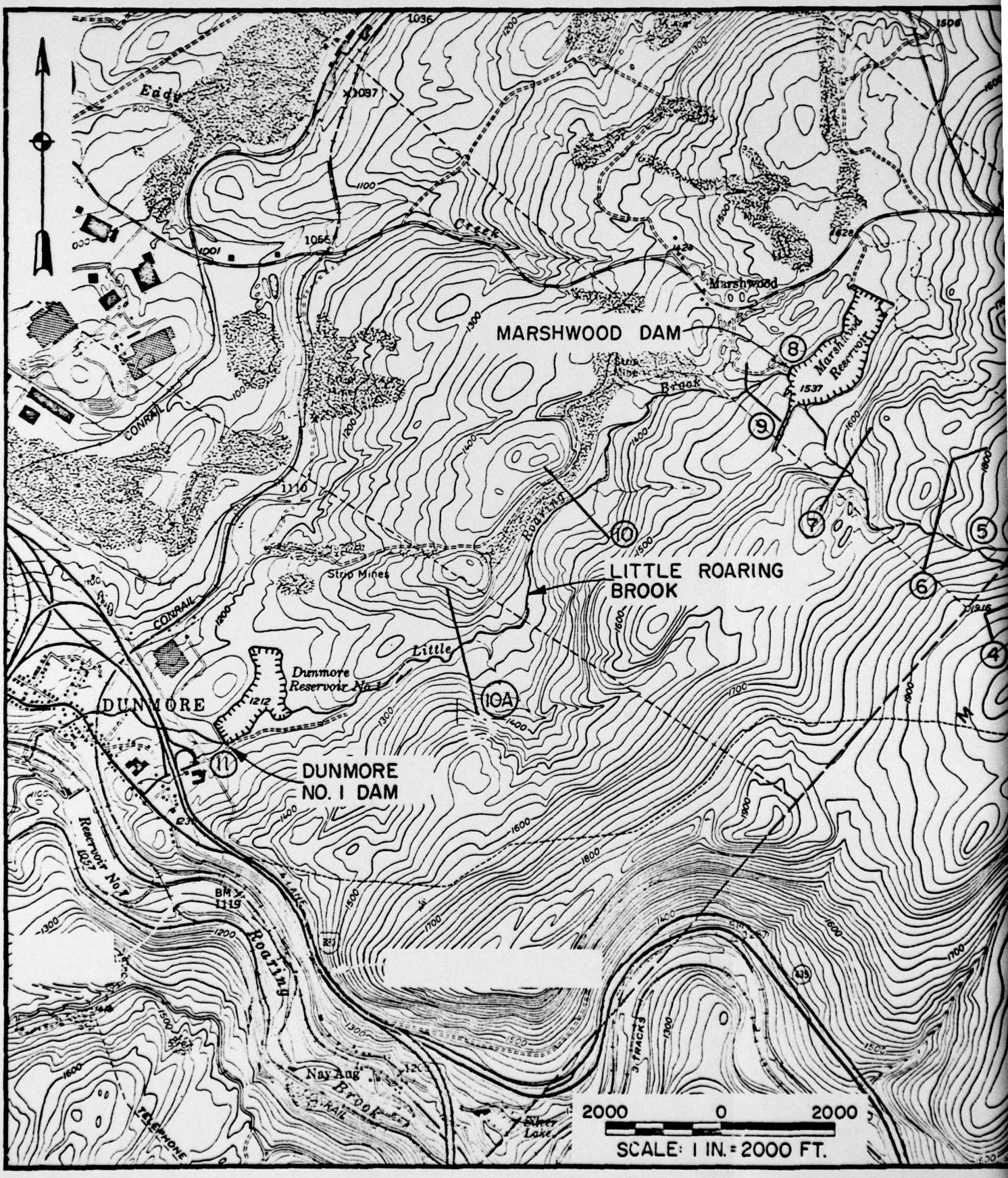
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

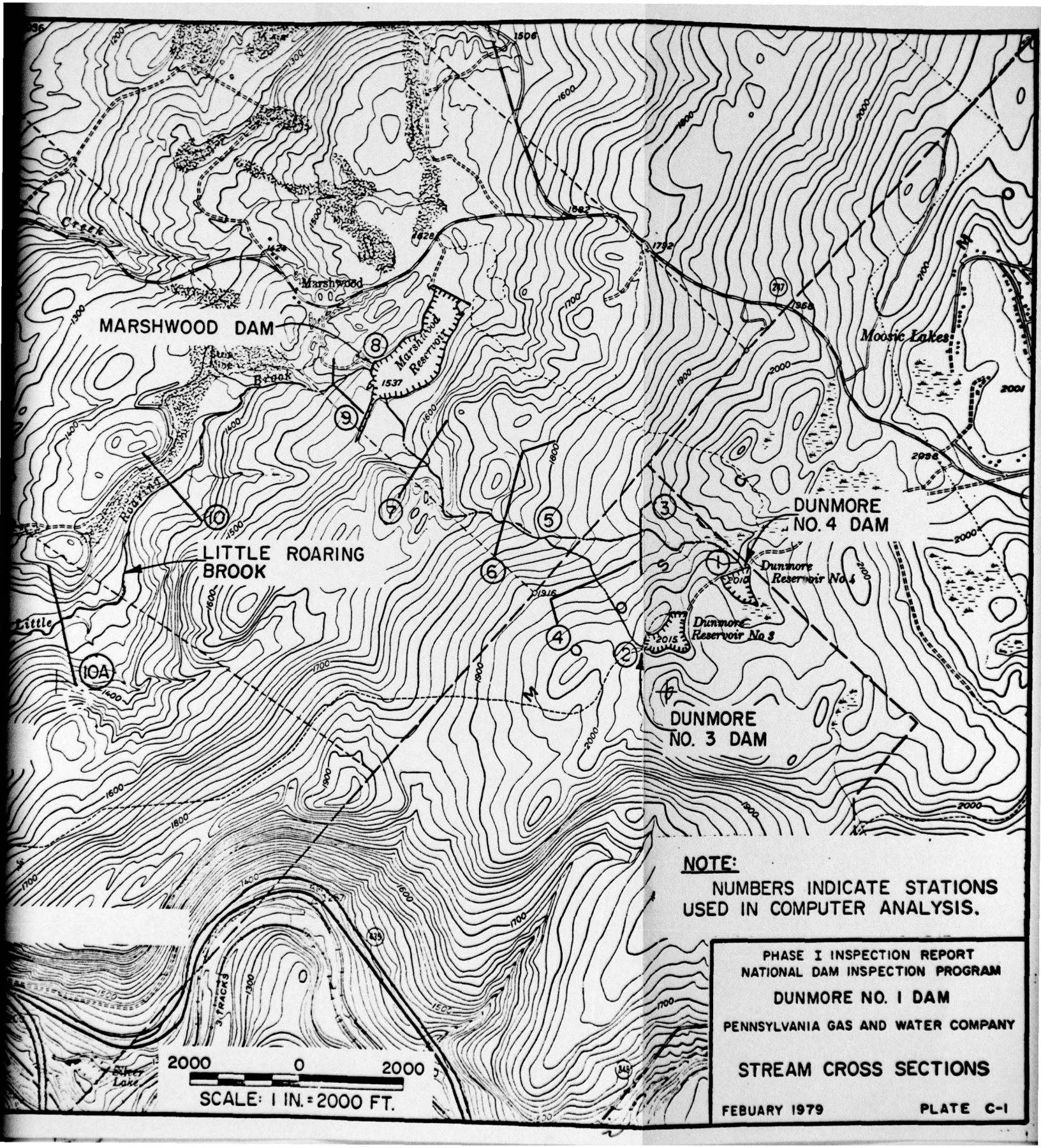
SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SUMMARY OF RESULTS
(DAM WITH EXISTING CONDITIONS)

PMF RAINFALL = 24.9"

	PMF	½ PMF
TOTAL RUNOFF (INCHES)	22.4	11.2
DUNMORE NO. 1 DAM		
INFLOW (CFS)	11,235	5,433
OUTFLOW (CFS)	11,091	5,280
DEPTH OF OVERTOPPING (FT.)	0.74	—


MARSHWOOD DAM
LITTLE ROARING BROOK
DUNMORE NO. 1 DAM
Dunmore Reservoir No. 1
Marshwood Reservoir
DUNMORE
Eddy
Creek
Roaring
Brook
Little
Strip Mines
CONRAIL
Nay Aug
Silver Lake
3 TRACKS
TELEPHONE
BM X 1119
1212
1537
2000 0 2000
SCALE: 1 IN. = 2000 FT.



NOTE:

NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DUNMORE NO. 1 DAM

PENNSYLVANIA GAS AND WATER COMPANY

STREAM CROSS SECTIONS

FEBUARY 1979 PLATE C-1

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

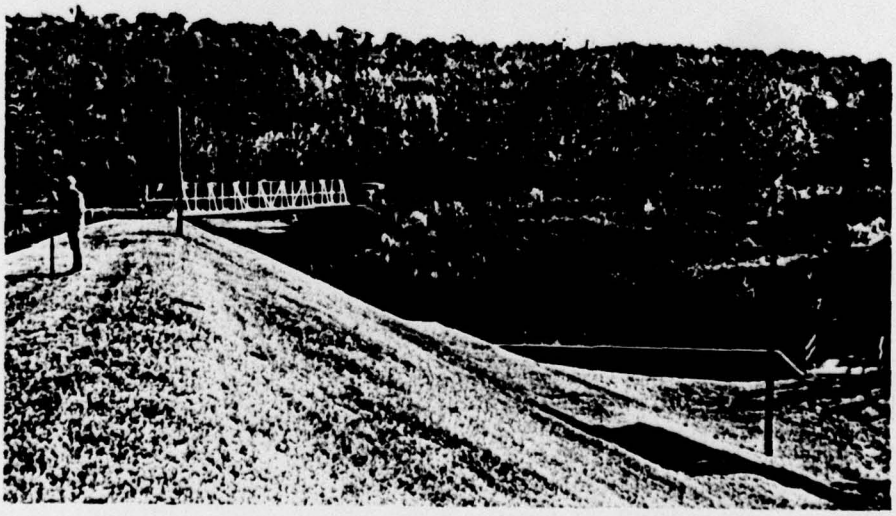
FEBRUARY 1979

APPENDIX D

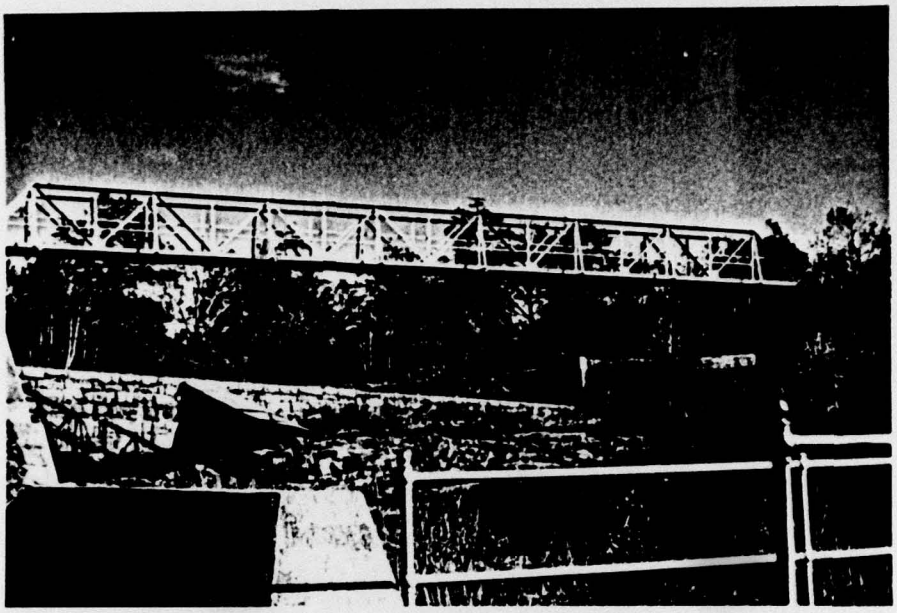
PHOTOGRAPHS

DUNMORE NO. 1 DAM

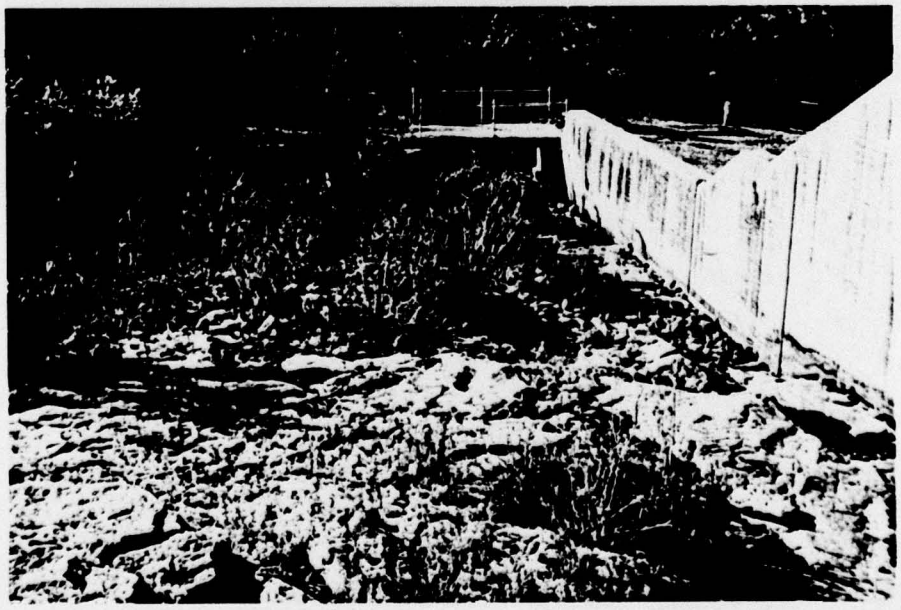
A. Embankment



B. Downstream Slope

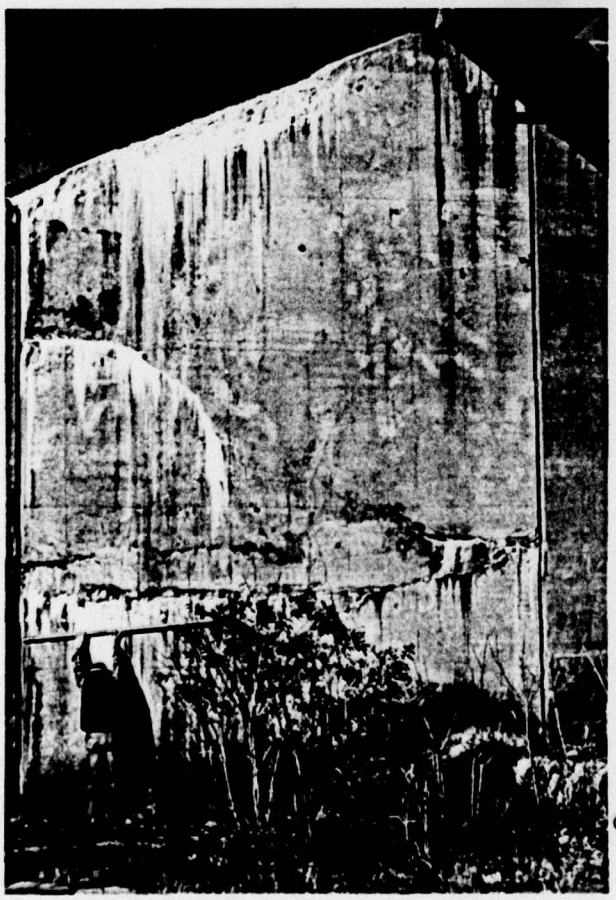


C. Spillway

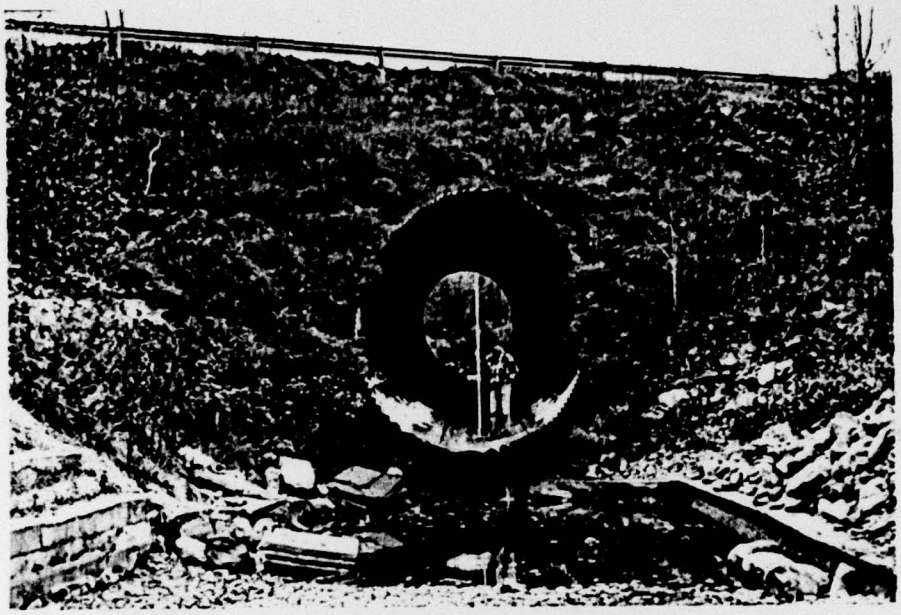


D. Spillway Outlet Channel

E. Upstream Slope



F. Crack in Wall
on Right of Spillway Outlet Channel



G. Culvert under Local Road

H. Culvert under Interstate 380

Note: Both culverts are immediately downstream of the dam.

SUSQUEHANNA RIVER BASIN

LITTLE ROARING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

DUNMORE NO. 1 DAM

NDI ID No. PA-00364
DER ID No. 35-25

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

FEBRUARY 1979

APPENDIX E

GEOLOGY

DUNMORE NO. 1 DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S 35°-40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville formations (youngest) through the Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

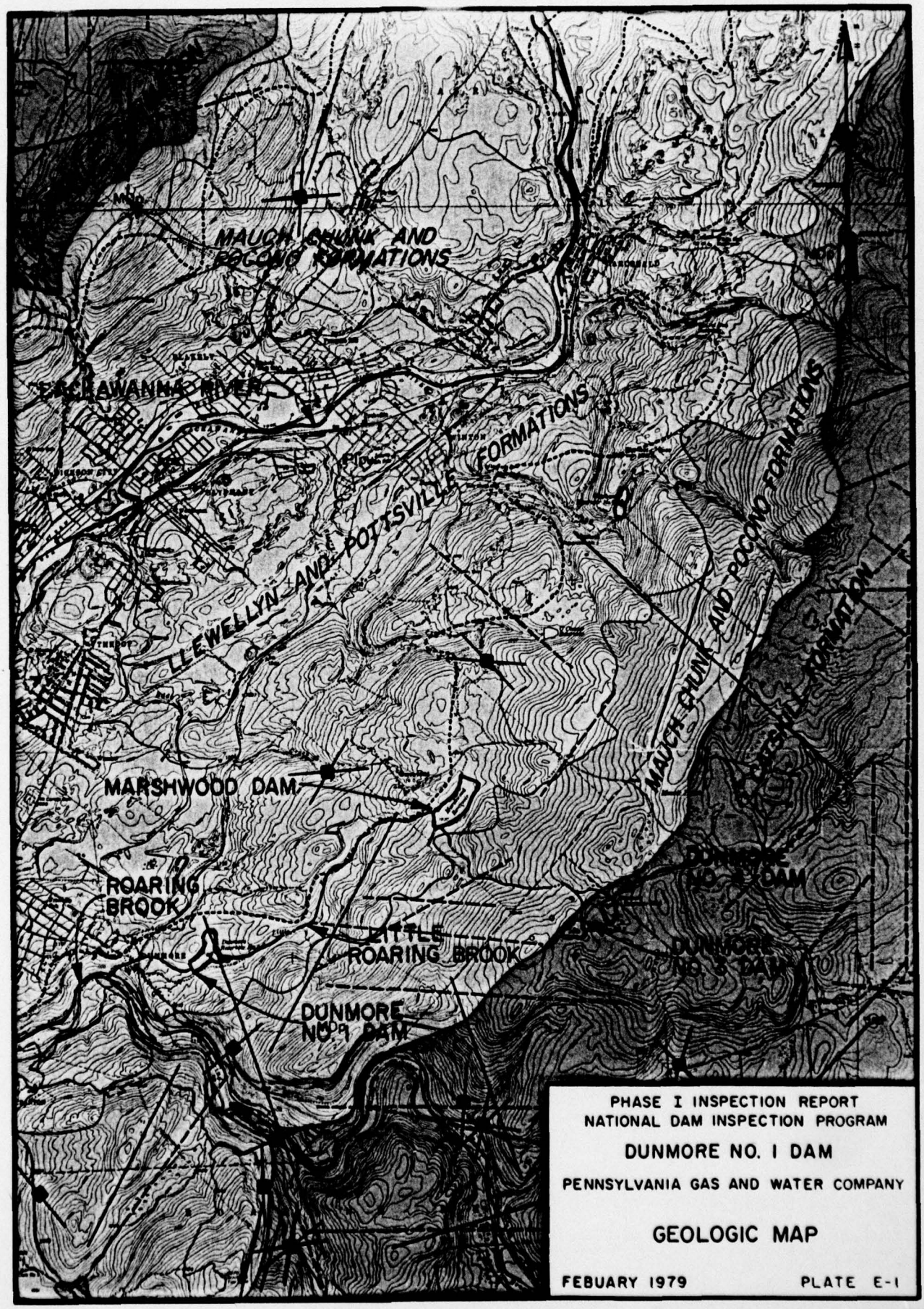
The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Little Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a tortuous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed in founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. Dunmore No. 1 Dam is founded on coarse Pottsville conglomerate of Pennsylvania Age. dip to the northwest. An excerpt from the 1914 Pennsylvania Water Supply Commission reprot states that:

> "The rock in the vicinity is of a good grade of conglomerate, compact and durable, as shown by the sound outcrop at the south end. This formation follows across the valley to a point about 60 feet from the opposite end, where it suddenly drops off. Beyond this point quicksand was encountered, and after several unsuccessful attempts to excavate a trench, the contractors drove piles, one against the other, to an impervious strata, and after excavating the quicksand, filled in with large stones and concrete, to the elevation of the neighboring rock, and the wall founded on it. About 10 years after the wall was built a leak developed near the

northern end of the dam, and wooden piles were driven behind the wall to form a casing, the material excavated, a considerable amount of which was quicksand, and the space filled with rock and concrete. No trouble, due to seepage, has been experienced under or around the ends of the dam since that time."

The Pottsville formation is composed of light to dark gray, fine grained to coarsely conglomeratic sandstone; gray shales, limestone and coal. Bedding is generally well developed ranging from thin shale laminae to several feet in the sandstones. The predominent joint set in the area trends N 20° E. Sandstone present are generally moderate to highly resistant to weathering and form the crest and flanks of ridges.


MAUCH CHUNK AND POCONO FORMATIONS
LACKAWANNA RIVER
LLEWELLYN AND POTTSVILLE FORMATIONS
MAUCH CHUNK AND POCONO FORMATIONS
MARSHWOOD DAM
ROARING BROOK
LITTLE ROARING BROOK
DUNMORE NO. 1 DAM
DUNMORE NO. 3 DAM
DUNMORE NO. 1 DAM
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
DUNMORE NO. 1 DAM
PENNSYLVANIA GAS AND WATER COMPANY
GEOLOGIC MAP
FEBUARY 1979
PLATE E-1